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ADDRESS

Delivered on Monday, 18th May, 1857, by COLONEL THE HON. JAMES LINDSAY, Chairman.

GENTLEMEN,

IN commencing our Course of Lectures and Evening Meetings for this year, I hope you will permit me before we begin to make a few observations to you upon the state and prospects of this Institution.

I will first allude to the financial position. You will recollect that about five years ago, after we had spent the greater portion of our capital in building a Lecture Theatre and in improving the accommodation of the Institution, and were in fact for the first time in a position to carry into effect its original design, we were suddenly surprised by a demand on the part of the parish for poor's and other rates from which we had hitherto been exempt. Against this claim we appealed, but by an unexpected and adverse decision of the Court of Queen's Bench, we were burthened with an increased expenditure of 130*l.* a-year. This entirely paralysed our action, and made a demand upon our resources which we have been as yet unable to meet.

The effect has been that, for the last five years, with the exception of 1853, the ordinary expenditure has exceeded the ordinary income. You are aware that by the rule and practice of the Institution all Life Subscriptions must be funded, as being the capital of the Institution; this being the course not only due to those who compound for Life, but a practice dictated by policy and prudence. We have been unable to continue this course of action, and are now in debt to our capital upwards of 200*l.* But this is not all. For the last ten years we have had to pay a rent of 200*l.* a-year to the Crown, which with other charges amount to no less than 430*l.* a-year, being equal to one-third of the ordinary income, and to the subscription of 860 members. It is unnecessary for me to trouble you with any remarks upon the sort of almost checkmate such a burden imposed. Though our position may be at present unsatisfactory, yet there is hope in the future; for after years of perseverance we have at last succeeded in obtaining the countenance of the Government, who, though unable to remit the charges we have to pay, have proposed to give us a sum with which to pay them. This will restore us to that position we were in ten years ago, but with this drawback, that, whereas our income from annual subscriptions was about 1,400*l.* a-year, it has now fallen to 1,200*l.* a-year.

I must now draw your attention to what must be admitted—that we do not enjoy that hearty support which an institution of this description ought to receive from the officers of both army and navy. The subscription of ten shillings a-year is so insignificant that it is impossible to suppose for one moment that it deters many from becoming members. We must therefore look to those natural causes which to some extent govern men. The two services (and in the military I include the East India, Militia, and Yeomanry services) are composed of officers who are serving their country in different localities—some in remote stations at home, others in distant colonies. To give an institution of this description any chance of success, it must be in London, where all facilities and appliances

exist to bring it to the highest amount of perfection. At the same time, it is evident that even those officers who are serving at home only visit London occasionally, and when they do, they have probably engagements which during the short time they are here present greater attractions than this Institution can afford. It must also be remarked that during the last few years the officers of the army have considerably changed. The greater portion of the officers have entered the service during the time the Institution has been unable to exert itself, and have therefore little or no knowledge of its existence, character, or object. This is no doubt to be ascribed to the resources of the Institution not permitting that extensive printing, advertising, and circulation, which would keep it prominently before the services: these causes and the effect of the late war have at any rate produced the following results, shewing a considerable falling off in the officers on full-pay since 1844; as the table which I now hold in my hand will show.

	1844.	1857.
Household Cavalry	24	49
Cavalry	129	69
Artillery	167	94
Engineers	123	84
Guards	140	226
Line	584	189
Navy, all ranks	845	556
East Indian Service	165	151

So that, except in the Household Cavalry and Infantry, from whom a unanimous support may naturally be expected in consequence of their station in the metropolis, there has been a large decrease of members.

It is evident that we must seriously consider in what manner we must recruit our numbers, for on numbers, from the smallness of the subscription, we must rely. It is only reasonable to suppose that there is a certain class of officers of ample means, who, if they were aware of our requirements and were con-

vinced that the Institution deserved professional support, would from professional *esprit* and pride give their assistance. But there is another and the larger number who with reason urge that the Institution is of no immediate benefit to them, and consequently they are unwilling to subscribe to it. I hope the time is approaching when we may not only increase our numbers from a feeling that officers are supporting an Institution which the services ought to be proud to call their own, but that we shall be able to give our absent members something in return for their subscriptions, and keep them acquainted with all that goes on within our walls. The income set free by relief from taxation will enable us to print and circulate a Journal of our Proceedings. And here let me say, that I conceive nothing could be more fatal to our interests than to rely upon anything else than our own exertions, and the voluntary support of officers. Beneficial as the relief expected may be, if our numbers become reduced, we should soon be no better off than we have hitherto been. Our course must be, not only to maintain our present strength, which requires recruiting for the supply of vacancies to the number of 140 a-year, but to increase this number largely, and we require not less than 500 new members to place the Institution in that position which can render it thoroughly effective.

I will now say a few words as to the course we propose to pursue to raise the position of the Institution. All other professions have establishments for imparting professional knowledge and general information. In the learned and scientific societies of the country, naval and military science has been hitherto unrepresented and unrecognised; it is the province of this Institution to fill that vacancy and become to the services what the museum in Jermyn Street is to geology, and that of Kew to botany. We have among our members officers of the highest talent and ability, eminently capable of imparting the knowledge they have acquired, and of giving the service the benefit of their experience. The professional papers of the Royal Engineers are of the highest

order, and amply prove what I say. We hope to obtain the service of distinguished officers for our Lectures, and already I am glad to say that Colonel Dixon of the Royal Artillery, Colonel Wilford of the Hythe establishment, the Chaplain-General, and Colonel Macdougall of the Sandhurst College have granted their services. We propose also to continue meetings for the purpose of discussing professional and scientific questions, and to encourage inventors to exhibit and explain such inventions as have connection with the professions. It must also be remarked that articles of warlike character are placed for exhibition in the Society of Arts, whereas, if this Institution held the place in a professional light which it ought to do, such articles should be exhibited here. It will be the duty of the Council to provide the means of facilitating such exhibitions. In the Journal of Proceedings we propose to print the lectures, or an abstract of the lectures, and the discussions which take place. The numbers will be issued three or four times a year, and sent to all members serving in other parts of the country and in the Colonies. They will contain every information connected with the Institution—the new members; a list of donations and presents; and we shall form two scientific Committees, one Naval, the other Military, for the purpose of assisting the Council in all questions relating to science.

In this manner we hope, by giving officers a *quid pro quo*, by making the Institution practically useful, by promoting and encouraging information which must be beneficial, to obtain the hearty concurrence of the officers of the several services —a course which, we trust, will not only raise the character of the Institution, but the character of those who compose it.

In pursuance of the plan detailed, we propose to send an address to the officers of the several services, detailing our objects and requesting their support. We have received an expression of cordial good-will from many general officers of districts, and from many of our members in different stations. Though for reasons already expressed we may not be so successful as we would wish, yet the address will have the effect of im-

pressing our designs upon the officers and make them acquainted with the merits and objects of the establishment.

We have also reason to hope that we may receive support from the collateral services of the Yeomanry and Militia. In these two services there exists considerable military *esprit*, and a great anxiety to assist the welfare of military Institutions. Several of the most zealous of their officers—Colonel Adair, Colonel Gilpin, and Colonel Smyth—have recently joined the Institution; while the late Speaker of the House of Commons, one of the most distinguished commanders of Yeomanry corps, became one of our life-members last year.

Upon the whole we have every reason to be sanguine for the future, and that we have passed the most difficult period of our career; and I trust it will be the pleasing duty of the future Chairman of the Council, in opening the lecture season, to congratulate you upon the successful progress of professional science, as developed by the proceedings of this Institution.

Gentlemen, before I sit down, I cannot help drawing your attention to the loss which we sustained a few days ago, by the death of Lord Radstock. He fulfilled the duties of Chairman of the Council of this Institution upon two occasions, and every one who was acquainted with him must bear testimony to the kindness of his disposition, and the high character which he bore, not only as a naval officer, but as a person who in his sphere of life was noted for every charitable and benevolent action. He was one of our Vice-Presidents also, and it is a loss which we most deeply deplore.

We have also to regret the loss we have sustained by the death of our Secretary. As you all know, Mr. Tonna had for some years been in a declining state of health which almost incapacitated him from work—in fact we may say that we have been without a secretary for some time. He devoted the best part of his earlier life to the Institution. He was a man of very considerable acquirements, and, previous to his long illness, the Institution derived great benefit from his attention and abilities. He died a month ago, and it became our duty

to fill up his place, and I have now to introduce to you Captain Burgess, who is now on my right hand, whom the Council at the last meeting elected to act as Secretary and Curator to this Institution. I must say that the Committee which had to investigate the testimonials produced upon that occasion were perfectly satisfied of his qualifications to act in that capacity, and from what I have seen of Captain Burgess since he has been here, I am sure that he has anxiously devoted himself to the benefit of the Institution, and I feel certain that the members of the Institution will cordially coincide with the Council in the choice which they have made.

LECTURES.

Fridays, May 1 and 8, 1857.

COLONEL THE HON. JAMES LINDSAY in the Chair.

ON FIELD FORTIFICATION.

By CAPTAIN LENDY, *late of the French Staff, Director of the Military Institute of Sunbury.*

IT ought never to be lost sight of that in every description of warfare fortification is only an accessory, destined to increase the power of resistance of troops; and that works, particularly in the field, are only resorted to when we are weaker than our adversary. Fortification should not, therefore, paralyse the action of the troops, *as has too often been the case*, but give full scope to their efficacy.

Cavalry can only act offensively; infantry and artillery can act both on the offensive and the defensive, and for the latter alone is fortification employed. It should at the same time protect them, and enable them to concentrate their fire so as to give it its fullest effect, conditions concisely expressed by a celebrated engineer, "It must *cover and flank*." To these we might add, it must also *make the*

most of the ground, for, in fortification more still than in tactics, it is true that bravery is worth more than numbers, but the nature of the ground is often of more use than bravery.

The study of topography is therefore the necessary complement of that of fortification, and, to obtain good results, both sciences should be learned simultaneously.

The attack of fortifications is also entrusted to infantry and cavalry alone.

We sometimes hear of cavalry storming field-works. This is wrong. Cavalry cannot storm a work; but it may turn it, and when the gorge is not defended by palisades, barriers, &c., it can rush on the garrison, and become master of the intrenchment. At the battle of Borodino (1812), the French cavalry thus took the Russian redoubts. A similar occurrence had taken place in 1760, near Weissen-Hirsch, when the Austrians were marching to the relief of Dresden.

Every one will readily understand the destination of the various parts of a work, the ditch, the parapet, the glacis, &c., and even calculate the dimensions of profiles. The nature and value of the different obstacles, such as palisades, chevaux-de-frise, &c., as well as the employment of artillery, will not long remain a mystery to the student. There will be no difficulty in remembering the different names given to the various tracings, and in appreciating the defects of undefended and dead angles on one hand, and the advantages of cross and flanking fire on the other; but what is not easily learnt is the application of these tracings to varied ground, so as to derive the greater protection and advantage from a limited amount of labour and time. Every other question of fortification sinks almost into insignificance before the "selection of a proper outline;" it implies both experience and ingenuity, and it is there that fortification is no longer a civilian's but a soldier's science. For the attack, this intimate knowledge of the ground, blended with that of the tracings, are again the chief requisites of a good engineer.

In selecting an outline, it is obvious that the ground is the first element to be considered, but it is not the only one: we must also bear in mind the end for which the work is designed, and the force of the garrison destined for its defence. Again, the amount of

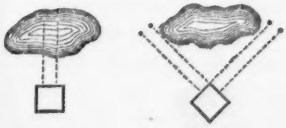
labour, and the time required to throw up the work, may further induce us to modify this outline.

With regard to the ground, and the purpose of the work, no absolute rule can be laid down; here all is left to the ingenuity of the officer, and none should ever forget that it is not by difficult and complicated tracings that he will display his skill.

If a bridge thrown across a river is to be defended by a work, the figure shows that a redan would not answer the purpose if the river ran in a straight line; the assailant being in fact unexposed in his approach on the ground *A* and *B*; this outline would, on the

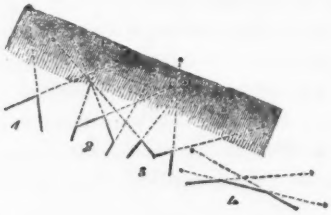
contrary, be good when the river presents sinuosities; the lunette should be preferred on the first supposition.

If a marsh or ground impassable to the enemy is in the vicinity of a position, it would be absurd to place a face parallel to the obstacle, since its fire would be lost; on the contrary, in directing a salient towards it, we at once obviate the want of fire on the capital.

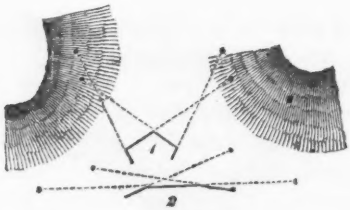


If a work must be thrown up close to a commanding height, the

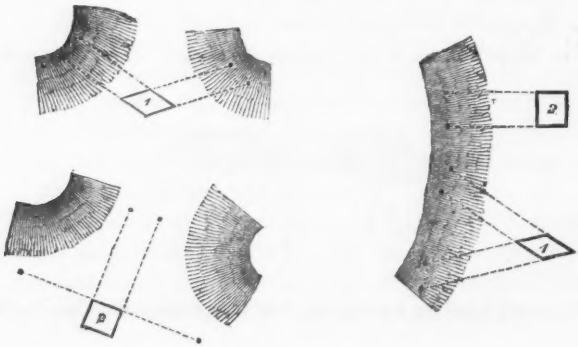
outlines 1, 2, 3, would give faces exposed to enfilade and reverse fire; the outline 4 should be preferred.



If the work is to be constructed in a valley between two commanding heights, outline 1 would again be absurd, so would be any other but figure 2.



Again the redoubt 1 has all its faces exposed to enfilade and reverse fire, while redoubt 2 has better conditions.



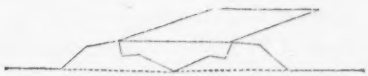
Examples of this kind could be multiplied *ad infinitum*, but a perusal of former campaigns is the best exercise that can be recommended to an officer desirous, in time of peace, of acquiring information, if not experience, on this delicate subject.

To fix the strength of a *garrison*, it is usual to compute two men for every yard of the crest of the parapet in open works, thus:—a redan destined for eighty men should have forty yards of parapet. Besides the men stationed on the banquette, a reserve is placed on the terreplein; it is generally a third of the whole garrison.

If a lunette having ninety yards of parapet is to be garrisoned, the detachment should muster 270—180 on the banquette, 90 forming reserves.

If two files of men be judged necessary for a good defence, the garrison should be calculated in the same manner: 360 for the banquette, 180 for the reserves. The same data will serve for lines; but, as these are defended by numerous armies, the calculation need not be very exact, inasmuch as there is a sufficient number of men to line the banquette in one, two, or three files.

When the work is an inclosed one, the terreplein must afford sufficient accommodation to the defenders for bivouacking, and its surface must enter into this calculation, fifteen square feet being allowed for every man. The dimensions of inclosed works are determined from this condition. Let us suppose a square redoubt. It is clear that the distance between the crest and the terreplein being four yards (about), a square redoubt with faces equal to eight yards would have no terreplein, and could not therefore be occupied.



In increasing the dimensions of the faces, the surface of the terreplein increases rapidly, and the length of the face can be calculated so as to give sufficient surface for its garrison. In supposing one man per yard of parapet, and no reserve, it is found that the smallest square redoubt would have fifty-eight feet for side, and 77 men for garrison. But a work of this description is also impossible: the terreplein would be so crowded, that room would not even be left for the fall of a shell.

To obtain a work giving sufficient accommodation, it is necessary to count a reserve of one third, and a minimum redoubt is obtained, fit for occupation. With two men per yard, or three, the mininum can be found.

In making this calculation, when artillery is employed, it must be borne in mind that a gun takes 15 feet of parapet, and requires from 400 to 600 square feet of the terreplein. About 500 feet are, besides, taken by the mask of earth (traverse), usually constructed in these inclosed works to mask the passage left for the entrance and egress of the garrison. By the same consideration, the minima of pentagonal or hexagonal redoubts would be found.

As for Star Forts and Bastioned Forts, there is no need of making such calculation for them, because there is always more interior space inclosed than is required for the garrison.

The minimum of such works is obtained from other considerations. For Star Forts, the faces should not be less than 30 yards, to avoid dead angles, which gives 360 yards of parapet for 6 salients and 1080 garrison; 480 yards for 8 salients and 1440 men; and for Bastioned Forts the length of the smallest fronts has been shown to be equal to 200 yards. The perimeter of a square fort with perpendicular $\frac{1}{8}$th. and face $\frac{1}{6}$th is equal to 920 yards, and has a garrison of 2760 men.

The force of a detachment being known, the perimeter of an open work calculated on the base above-mentioned, $\frac{1}{3}$rd of the force ($\frac{2}{3}$rds for the banquette, $\frac{1}{3}$rd for the reserve), the choice of the outline will depend upon the amount of labour and the intrinsic value of the work. Thus, instead of a redan, having a development of parapet of 180 yards, and faces of 90 yards, a double redan would be better.

In the same manner, instead of throwing up a redoubt of 360 yards perimeter, a Star Fort should be constructed, since its defence is better, and the amount of labour the same. Again, to a Star Fort of 920 yards parapet, a Bastioned Fort should be preferred.

After the selection of a proper outline, the chief point to which an officer ought to direct his attention is the execution of the work itself. A work, however good on paper, is not a work until it is altogether executed and ready for use. Here again "practice" is the only book to be studied on this important subject.

Field-works are often thrown up in a great hurry, and care must be taken not to begin a work unless there is a certainty of having it completed in due time. The following data will serve as a basis, in supposing the number of men employed on the déblai to be the greatest possible:—

A work of	8 ft.	relief, with parapet	9 ft.	thick, requires	8 days.
„	7 ft.	„	7 ft.	„	6 „
„	6½ ft.	„	6 ft.	„	4 „
„	6 ft.	„	4 ft.	„	2 „

To obtain approximately the time required for a work of greater relief, multiply the thickness of the parapet by that of the relief, expressed in yards; the product gives the number of days. A work ten feet high, with a parapet twelve feet thick, will then require about $3{\cdot}3 \times 4 = 13{\cdot}2$, between thirteen and fourteen days. In urgent cases, this time may be reduced by half in excavating on both sides.

It is not always possible in the field to throw up works with accuracy. The chief of a detachment, when receiving news of the arrival of the enemy, cannot waste time in calculations, but he sets his men to work at once, and makes them excavate a trench that will give a cover, which, time permitting, is afterwards converted into a regular breast-work. Tools may be wanting, then recourse is had to such accidents as the ground may present. It would require volumes to enter into the never ending details of the peculiar circumstances in which the vicissitudes of war may place an officer. If he be well acquainted with the spirit of fortification, it matters but little if he cannot recollect figures and dimensions; his sagacity will suggest what is best to be done.

It is needless to tell him that if he has to defend a village against

an enemy having artillery, he must remove the thatch from the roofs, barricade the streets, &c.

A mere wall will become for him a good cover.

A hedge, with little trouble, will be transformed into a breast-work.

The slope of a hill, by merely cutting down the inequalities it presents (an operation called scarping), will render his position difficult of access.

The more one investigates this subject, the more convinced one becomes that military history is the best complement of all military sciences. There indeed we see that much can be done with little means.

In India sun-dried bricks, mud, and even tiers of camel saddles have served to construct intrenchments. At Paris paving-stones have answered the same purpose. At the attack of Edinburgh (1688), at Fort San Christoval (1810), at Burthpoor (1825), in America, &c., cotton bales and wool packs proved of great advantage. At Lisbon (1810) scarping was employed on a large scale. At San Sebastian (1812) a redoubt was erected with casks to support the trenches of attack on the isthmus, &c.

A garrison in the defence of a fortress is often, if not always, obliged to have recourse to field-works.

When ravelins and bastions have been breached, permanent fortification has fulfilled its part, and the defence of the breaches may be considered as a branch of field fortification. It is indeed the most important item of the defence, and military history proves that a determined garrison can, by skilful dispositions, fight at a very great advantage at that critical period.

When the Constable of Bourbon had ruined the ramparts of Marseilles in 1544, the breaches were so skilfully and gallantly defended, that the Imperialists were compelled to raise the siege.

At Maestricht, in 1676, a French garrison of 6,000 men so vigorously fought for the defence of the breaches, that the Prince of Orange was obliged to give up any further attempt, and to retire with a loss of 12,000 men.

The breaches of Turin (1706) were defended by large fires, and successfully too.

St. Jean d'Acre was besieged in 1799 by Napoleon, and, although

the ramparts had been overthrown, all assaults proved unsuccessful, and the French had to retire, leaving their guns behind them.

In many other instances the Turks have given us a good example to follow, especially in the Russian campaign of 1828.

At Badajoz, in 1811, the English were repulsed at every assault. In 1812, the same place again resisted, and if General Picton had not surprised the Castle of San Christoval, the vigorous defence of the breaches would again have saved the place.

Even when the besiegers have gained a footing in a fortress, all hope of further resistance is not lost.

Prince Eugene at Cremona was obliged to retreat; so were the English at Berg-op-Zoom. At Saragossa, in 1809, the French had to besiege almost every house.

Fortification, it cannot be repeated too often, is only an accessory: the best work is a solid regiment, the best fortress a good army. The defensive in war is to be avoided. When therefore art is employed to increase the power of resistance of troops, it should be so contrived as to enable the defenders to assume the offensive when a favourable opportunity presents itself. Continuous tracings should be carefully avoided, and preference given to lines with intervals.

During the seventeenth and even the eighteenth century, continued lines were frequently employed to cover an army engaged in besieging a fortress, or to defend a position; but experience has rendered us wiser, and we no longer employ them in a siege, but have recourse to the lines with intervals whenever we require to defend a position of some extent.

At Arras, in 1634, Turenne made three false attacks on the lines constructed by Condé and the Archduke Leopold, and succeeded in forcing them.

In 1656, at Valenciennes, the lines of Turenne were also forced by Condé.

In 1706, at Turin, Prince Eugene defeated Marsin, who awaited him behind his lines.

In 1793, the Prince of Cobourg, commanding the Austrian forces (60,000), was attacked in his lines at Wattignies, by General Jourdan, at the head of 40,000 French troops, and was compelled to raise the blocus of Maubeuge.

It was during the Seven Years War that the Prussians and

Austrians had recourse to powerful combinations of lines with intervals. The most remarkable were those of the King of Prussia, near Jauernig; those of H.R.H. Prince Henry, near Liebenthal, in 1759; those at Colberg, in 1761; and those of the Austrians at Dippoldiswalde, in 1759; at Roxdorff, in 1761; and upon the high Eulengebürge, in 1762. In the Peninsular war the most celebrated were those constructed at Torres Vedras, by the Duke of Wellington, in 1810.

With regard to the employment of fortifications for the defence of a country, it may be observed that fortifications have been employed to defend frontiers more by *routine* than from imperious necessity. Systems, too, have been proposed for that purpose. The most ancient plan, which bears the name of Vauban, although this engineer often complained that too many fortresses were built, is designed to cover a frontier with a triple line of fortified places, with the view of detaining the invader as long as possible with small forces whilst an army is being organized.

At present, however, invading armies are numerous enough to pass between these lines without having much to fear from their small garrisons, and the examples of Holland in 1794, and of France in 1814, lead us to inquire whether this enormous outlay on artificial defences is not altogether useless.

We have seen the Romans at Trasimene and Cannæ, Hannibal at Zama, Scipio at Thapsus, Sextus at Munda, Melas at Marengo, Mack at Ulm, Brunswick at Jena, defeated, and unable to rally their forces even amidst their fortresses, and close to their capitals.*

In this system, routine had the greatest part. After the struggle of the middle ages, Europe was seen dividing itself into a limited number of kingdoms; these swallowed up the states of smaller importance, enlarged themselves by the addition of dukedoms and earldoms, and sought to establish themselves on strong bases. Of all fortifications, those which nature supplies are still the best; but every state could not succeed in obtaining for itself such boundaries; even to the present day the coincidence of political with natural divisions is regarded as an impossibility. It happened that to restrain a too warlike nation—to keep in check a too powerful

* Montholon, *Mémoires de Napoleon*, tome ii. p. 20.

country—the European states imposed on each other frontiers of an irregular shape. The consequence was, that in order to protect the defenceless part of these frontiers and to close the openings, citadels were erected. Political events changed, and with them the frontiers advanced or retreated as the tide of the sea. At every change the same phenomenon took place, and it is in this manner that the surface of European states offered so great a number of fortified towns, scattered without any apparent combination.

In France, Vauban and his successors improved all *these* fortresses, and, as several lines were found to exist, it was taken for granted that they were built according to the regular system alluded to.

It has been said in defence of this system, and it is still repeated, that an invading army would not dare to venture in a hostile country leaving several fortresses in its rear, because its communications would be cut off. But the invading army is exposed in a limited number of points only to the combined and therefore uncertain attacks of the garrisons, each about 6000 men strong. What may be the strength of the invader? Experience shows that there is no exaggeration in valuing it at 300,000 men. If this army leaves on the frontier a corps of 50,000 men to observe the fortresses, their garrisons could not go far off without exposing themselves to be carried off by a much superior mass, and there will be still left 250,000 men to march into the interior of the country. But *they* would not dare do so! Why? The defensive army, already inferior since it is on the defensive, has been diminished, owing to the necessity of placing garrisons in every fortress—in *every one*, since it is not known which of them the invader intends attacking. For a frontier of 150 miles, requiring about 21 fortresses, the defensive army loses 125,000 men condemned to remain inactive! If in 1814 Napoleon had not scattered garrisons in Dantzick, Homburg, Magdeburg, Wurtzburg, Glogau, &c., and had collected these forces on the Rhine, they would undoubtedly have delayed, if not altogether prevented, the invasion. The great accumulation of fortified places on a frontier has, besides, the inconvenience of entailing a very heavy expenditure on the State. Valuing the mean cost of a fortified town at 600,000*l.*, how many millions will be swallowed up by a

frontier 150 in length? Look at France, who numbered 186 fortresses in 1829, and judge of what she pays for their maintenance alone. Bureau de Pusy, in 1791, said that with that amount he could organise an army of one hundred thousand men.

Modern statesmen have laid aside this system, and proposed new ones. Among the most celebrated we find General Rogniat's method of *Retrenched Camps*. He proposes to leave the frontier open, and to entrust the defence of the country to a numerous army, that will find support in a series of retrenched camps resting on fortresses, and distributed from the frontier to the central stronghold, in such a manner that the army could always find one within fifty miles. He intends this army to defend the country while other forces are being organized, checking the advance of the enemy by skilful manœuvres, and driving him to attack the defenders on their prepared ground of the retrenched camps. This system, which has been favourably received, has not yet been put into operation. It is therefore difficult to decide upon it. It starts, however, from a *true principle*—that of entrusting the defence of a country to the *army*, and not to *mere* fortresses. But the invader can also have recourse to skilful manœuvring, and march directly upon the capital, which, according to General Rogniat, is not fortified.

General Duvivier proposed to have only one place in a country—but an immense one, 40 miles in diameter!—where all the resources of the State are to be accumulated, so as to preclude the idea of ever attempting its attack, whilst the defensive army struggles on the frontier. Unfortunately, before arriving at the realization of this *delta*, the manners, government, &c., of our times must greatly alter.

The method which seems to be adopted now is to fortify the capitals, in order to secure them against a coup-de-main, and to have on the frontier fortresses provided with retrenched camps. In this country the sea forms a natural defence, and with the construction of batteries and forts around the dockyards and arsenals, it is by many considered as sufficient. Dreamers however have not failed to prepare plans for constructing a permanent system of defence by means of fortresses both along the coast and in the interior.

Instead of perusing all these plans, let us conclude with a few remarks.

A system ready-made is like a formula of algebra,* applying to all cases, common sense being sufficient to work it correctly; but in the defence of a country is a system advisable? Will the invader act exactly in the way foreseen? Will every fortress, line, &c., be called into play? The world of impossibilities daily diminishes, and more especially in war, where almost everything is to be considered as a probability, and provided against accordingly. Alexander, Hannibal, Napoleon, have astonished mankind by the boldness and novelty of their operations; and this may still occur. Therefore let us beware of these systems, ready-made and answering every purpose, and let *common sense* be our guide. The lines of Torres Vedras were a better defence for Lisbon than any bastioned or tenaille enceinte, yet they were mere field-works.

In this country especially, where an invader is obliged to cross the sea, where military ports are fortified and safe against surprise, there is plenty of time left to prepare *field defences* of the most formidable description. Let us at present remember that armies are more numerous and more rapid in their movements than formerly, and that a fortress has no influence but on the ground seen by its guns, and that is only when it is a place situated *there*, and *there* only, *where* the enemy *must* pass, that permanent fortifications are advisable.

Monday, 4th May, 1857.

COLONEL THE HON. JAMES LINDSAY in the Chair.

ON PERSIA AND THE PERSIANS.

BY LIEUTENANT-COLONEL SIR HENRY RAWLINSON, K.C.B.

(*Abstract.*)

SIR HENRY RAWLINSON gave a most instructive account of Persia, it being rendered the more interesting in consequence of the military operations in that country, and the daily expectation of news of

* General Duvivier.

the attack on Moham'rah. It had been originally intended to give Sir Henry Rawlinson's Lecture *in extenso*, but unfortunately his time had been so completely occupied by business connected with the state of India, that he was unable to prepare his Notes for printing.

Sir Henry divided his Lecture into four heads: The Geographical Divisions and Physical Features of the Country; The Inhabitants and their Characteristics; The Constitution and Organisation of the Army; and, Remarks upon the present War.

Persia has no resemblance whatever to any country in Europe, and with regard to the countries of Asia, Persia stands *per se*. It has none of the tropical peculiarities of India or of China, or of those countries with which Englishmen are generally acquainted. It is very different from Asiatic Turkey. It consists of an enormous plateau, a high table-land, shut in between two ranges of mountains, one of which runs to the north, and the other to the south-west; one being a continuation of the Taurus, and the other of the Caucasus. It is further intersected by ranges of mountains diverging from, yet forming parts of, these two great ranges, with small valleys intervening between them. The general character is therefore one of extreme sterility, and the want of water is the prevailing evil. Of course in a country so extensive there must be great diversity and variations of climate from extreme cold to extreme heat. In the north, about Tabriz, and along the mountains, the cold is much greater than in England, while in the south, in the Persian Gulf, and along the coast, the heat is much greater than in India. Another thing which strikes the traveller is the great want of wood. There is hardly any wood in the country, except in the low land along the Caspian, where there is a belt of about twenty miles in diameter, from the north to the south, thickly wooded with dwarf oak; with that exception, and that of the low land in Ghilan south of the Caspian, there is no wood: the hills are perfectly bare, and in the valleys the only wood is that which is grown in the gardens. There is positively not a hedge in the country, from one end of it to the other. The real evil, however, is the want of water, which the inhabitants endeavour to remedy as well

as they can by subterranean aqueducts; but water is so scarce that they are obliged to exercise the greatest ingenuity and labour, in order to secure a supply. Some of these works may be termed subterranean tunnels, and are as much as 300 feet in depth, and they are continued for a distance of 20 or 30 miles. These works are in fact the only means they have of carrying on cultivation in a mountainous country; without the water thus supplied they could not raise grain of any sort whatever.

There are a vast number of different races inhabiting this extensive country. The conterminous country between Persia and Turkey is inhabited by the Kurds. In that part they speak Turkish; Persian is utterly unknown—it is not exactly Turkish, but a Turkish dialect; on the Caspian, they have a sort of *patois;* but down the middle of Persia the Persian language is spoken. On the east, there is an enormous salt desert, with very few inhabitants. The character of the country is such that a traveller has described it as "the salt desert, and the desert that was not salt." This is a little exaggerated, although certainly the greater portion is desert; but there are rich spots, especially on the banks of the Caspian, well wooded, and well watered, full of mulberry trees, which supply about three quarters of the whole of the raw silk which is used in Russia, and which is of great value. The eastern province of Persia is called Khorassan, and is of very great extent. Khorassan is conterminous with Affghanistan and Herat, and in fact the word Khorassan, meaning the eastern country, is made use of in India generally to apply to the whole of Eastern Persia, as far as the confines of India, so that the Indian travelling across the Punjaub says he is in Khorassan; they think it is all Eastern Persia from the Salt Desert to the Indus.

Sir Henry proceeded to describe the inhabitants of the country. He stated there have always been in Persia two great ethnic elements, which have not been at all understood, or appreciated. There is what is called the Arian and the Syriac element. In the earliest times Persia was inhabited by tribes all belonging to that race which is called the race of Ham in the Bible, contra-distinguished from the Arians of India and of Europe: the Arians were Hindoo-European nations who extended from India

throughout Europe. At the present day in the mountains of Khorassan there are many remarkable dialects spoken, and which have very little connection with Persian, except in certain general features. The vocabulary is entirely different, and that vocabulary is absolutely the very same as the language of Babylon in the time of Nimrod, and distinguished entirely from the Assyrian, and the Simmitic; and, besides that, in the actual inscriptions of Persia there is always one translation given in this old language, which is particularly the vernacular language of Persia. Persia was originally a mere province of Kars.

After Cyrus had obtained possession of the whole empire, the name of Persia was applied generally to the country, by the people who constituted his subjects. They were Indians and Arians; and at present the language spoken by the people is more or less connected with the original language spoken by the Persians of Cyrus. In some cases it has entirely overlaid the old Syriac, but in others the Syriac predominates. At the present day the only recognizable distinction is between the Persians and the Turks. These Turks are comparatively modern colonists, for it is only about 1000 or 1,400 years since they first crossed the Oxus, and came into Persia, and at present half the population is Turkish, and the same race in fact as the Osmanli Turks, speaking almost the same language. The ethnic division at present is Persian and Turkish, but there is a still stronger division in the manners of the people. One half of the nation lives in tents, and the other half lives in houses, and this distinction is much greater than might at first be supposed, because it involves an entire distinction in the way of life. The former are mere shepherds; their life is pastoral, they live by their flocks and herds; the latter are agriculturists. The former, however, do attend to agriculture in a small degree; but, after they have sown their grain, they leave a few watchers while they attend to their flocks. In general those who live in tents have summer and winter pastures, and they migrate from one to the other with their flocks and herds: they derive all their notions of property from their produce. They are a people of particular interest, because they furnish the great mass of men for the Persian armies. They are the fighting class, and, as such, are of great

importance; because they are far superior in all the best qualities, both mental and bodily, to the Persians of the towns. They are comparatively honest, they are certainly brave, and they possess many of the characteristics of the hill or mountain tribes of Europe; but, at the same time, it must be confessed that they are extremely lawless, and they are under very little control, except that of their chief, and he is generally a lawless character himself, and encourages freebooting, and all those atrocities, as we call them, but which they think are virtues.

The army is derived chiefly from the tribes that have been described. There are in it four great branches—the Regulars, the Irregulars, the Artillery, and the Cavalry. The Regulars are, of course, the most important; and they are generally drawn from among the tribes, one from each family; and they serve sometimes for seven years, generally for life. The military service is not much liked, for very little care is taken of soldiers in Persia. There is no such thing as a commissariat; the pay is very small under any circumstances, and that very little is never paid—they have been five and six years in arrear. In Turkey they are sometimes two years in arrear, but there the soldiers are very well fed. The rations of the Turkish soldier are better than those of any European Army; but in Persia there is no system. The men get, nominally, a little bread, but they are very frequently reduced to anything they can get—grass or heps and haws, dry corn, or acorns, in consequence of there being no commissariat; but, with all that disadvantage, they are a wonderful people. As an animal, a Persian is the finest creature in the world, for an Oriental he is so certainly. They are fine muscular men, and their powers of endurance quite extraordinary. Sir Henry once took the trouble to calculate the distance travelled daily in all the marches of Abbas Mirza. The total distance he traversed was about 2500 miles, and the average distance of each day's march was 21½ miles, and it is perfectly unique in military history to find a march of 2000 or 3000 miles performed by an army of regular troops at the rate of 21½ miles per day. He remembered upon one occasion when he dismissed a regiment, the men of which lived above 150 miles off, that they all returned

to their homes on the third day. They consequently travelled at the rate of 50 miles a-day. The Persian army exists as it is through the English entirely. Some forty or fifty years ago we seem to have felt the necessity of making use of Persia as a defence to India, first against France, and afterwards against Russia. We supplied her with arms, money, and officers, and for thirty years English officers were with that Army, and all the discipline they have they owe to us; and when we read of the square that was formed in the action that lately took place between them and our troops, they were entirely instructed in forming that square by English officers. We are suffering now for our teaching; but, at that time, it was considered that the stronger Persia was the more advantageous it would be for us, and our object was to strengthen her. At the present day, probably the strength of the regular army is about 60,000 or 70,000 men; but that is distributed all over the country, and they could not bring more than from 20,000 to 30,000 regular troops to any one point, and these men, though physically so very good, are so ill commanded, and so ill fed, not paid at all, and ill clothed, that they would not be at all formidable in the field, that is, in front of a British army or any European army, but especially a British army.

The next branch of the army are the Irregulars. These Irregulars are chiefly armed with that weapon of which you have all heard in the Affghan War. It is a heavy matchlock. Sir Henry remembered on one occasion seeing a man, in a skirmish, across a river, on the Kurdish frontier do a remarkable thing. A party of horsemen came from the other side to reconnoitre. This man said he would like to have a shot at them. It was thought the distance was so great as to make it perfectly ridiculous; however, he unslung his heavy firelock from his back (and it weighed some 30 or 35lbs.), fired at the group, and broke it up. Sir Henry found afterwards that he had struck a man in the shoulder, and broke it; the distance was 1550 yards; and it is said a range of that sort is no very unusual thing. On this occasion there was a good mark; the group showed themselves on a rising ground, standing out against the sky, and thus presented a most

favourable object for a shot. The Persian swords are very famous, and are chiefly made in Kurdistan. Their temper is very marvellous ; but they are only of use for a particular method of drawing; they are of no use as Cavalry swords, or for a sheer cut; they can be made as sharp as razors. A sword-blade has been sold for 100*l.*

The most efficient arm of the Persian army is no doubt the Artillery ; this was established by Colonel Lindsay, afterwards Sir Henry Bethune, some fifty years ago, and has remained very efficient from that time to the present day. The Persians are extremely clever and inventive ; when they were at the siege of Herat they wanted heavier artillery, so they collected all the copper trays belonging to the different chiefs, and the bells off the mules, got up a foundry, made moulds, and cast at once three large guns, 64-pounders, on the spot, a thing which it would puzzle us to do in a mere desert. It is true the guns did not prove of any great value, for two of them burst immediately, and the third after a short time ; still they actually did cast the guns merely out of the mules' bells and the copper trays in the desert around Herat. The Persian cavalry is also a very efficient arm, and Persia is the only place at the present day where you can see 200 or 300 horsemen charge in chain-armour. The Kurds still wear chain-armour, and actually find it of great use. They ride small horses, very well bitted, and very high bred, and form most admirable irregular cavalry; but the cavalry generally of the nation has fallen off very materially from what it was fifty years ago. In those days they used to keep breeding studs, and they took a great deal of trouble with their horses; the chiefs of the tribes generally used to breed horses for their followers, but these chiefs became so powerful that the Government systematically repressed them; and now in all Persia they could not turn out more than 20,000 or 30,000 horse. When Nadir Shah invaded India he had about 50,000 or more cavalry with him.

Sir Henry next proceeded to say that he thought that we had been accustomed very much to underrate the difficulties of a Persian war, because the Russians have been uniformly successful against

Persia. In the last Persian War, Paskiewich, with 10,000 men, was able to overrun all Persia, that is, all the northern part, routing the Persians in the field, and taking and garrisoning four of their principal cities; and because all this took place we supposed that the Persians were a contemptible enemy, who would yield to the same degree of pressure from us. The north of Persia is very different from the south. When Paskiewich attacked Persia in 1827, he had his own frontier for a base; he had merely to cross the Aras from the Russian magazines, to find himself at once at the seat of battle, in the richest, and most open part of the whole country. There were no deserts to traverse, no mountainous defiles to penetrate; he came at once into a country richly supplied, and comparatively open, with the greater part of the inhabitants in his favour. As long as he remained in this province, he could do as he pleased, but if he had found it necessary in the sequel to advance into the interior, his famous campaign would probably have been a failure; but it so happened that the moral pressure was sufficient, and by merely occupying the country where he was, and threatening the capital, he obtained all that he wanted. Now it is supposed that we can do the same in the south; but that is a very different question. The only expedition that we can compare with this at all fairly, would be the expedition into Affghanistan. We know well the difficulties that had to be encountered there; but those difficulties, such as they were there, would be infinitely surpassed by the difficulties of the Persian War. When we attacked the Affghans, we had an illimitable command of carriage; we drew during that war 70,000 camels from the north-western provinces of India and from Scinde. At that time, certainly, we had not a very favourable base, because neither Scinde nor the Punjaub were in our hands, and our real military base was Ferozepore; but still the inhabitants were to a certain extent favourable to us, and we were able to get supplies through them. Again, we never had any difficulty in the carriage of our supplies in the Affghan war; but the famous passes of that country are really mere bugbears as compared with the Persian passes. Sir Henry had been through the passes into Affghanistan, and most of those in India and Turkey, and he considered the Affghan passes of no military strength;

they are simple defiles penetrating the chains of mountains at right angles, and through which, if you can command the heights on either side, the passage of a column is perfectly unimpeded: but the Persian passes are quite different; there are no ravines running through the mountains there; you have a sheer precipitous range, which you have to pass in the best way you can, sometimes zig-zag, and sometimes along the shoulder of the mountain, the exposed slope of the shoulder, where you cannot protect yourselves, and you must fight your way foot by foot, and yard by yard, in front of the enemy; and this it is almost impossible to do. Again, with regard to the inhabitants, in Affghanistan there were two or three rival classes of inhabitants, some of whom were fighting against the Affghans, and there were rival tribes amongst the Affghans themselves; and where one party was against us, we had the assistance of another. But it would be quite different in Persia. Let us consider now what our position would have been if we had carried on the Persian War. First, we should have to bring everything from Bombay to Bushire, a distance of 1400 or 1500 miles, by water, and, having got there, the first thing—however good the troops may be, however well-fed and disciplined—we should require will be the carriage of supplies, for the country offers none,—we must have either camels or mules; camels, we all know, are invaluable as means of carriage, because they browse, and live upon anything, the ordinary growth of the Desert being their favourite pasture; and they require no looking after. At Bushire you cannot obtain camels; and camels cannot be brought by sea; there are none in the country—or insufficient in number. You must have mules at Bushire; those can be brought by sea, but they require feeding like horses, and the more mules you have the more forage you are required to carry for them. And I think no officer would venture into a country like this without spare forage for his cattle, otherwise he might be completely brought to a stand-still. It might be to a certain extent avoided if we took up our position at Moham'rah—Moham'rah is at the north-west of the Persian Gulf, above the delta formed by the mouths of the Tigris and Euphrates—an attack upon which we may hear of any day. There we could obtain carriage, because camels are obtainable in

endless numbers in Turkish Arabia, and they could be marched down to Moham'rah. By making that our base we could obtain camels, and go a short distance up the country. But even then the difficulties of penetrating are greater than on the other road. It is absolutely impossible either for artillery or regular troops to cross the mountains.

The only tolerably easy way of entering Persia would be from Bagdad, using the Turkish territory as a base; but the Turks, being neutral in the present war, it is impossible so to use their territory, otherwise Persia might be assailed from that side with tolerable success. With regard to the Persian passes, supposing that we had all the carriage that we required, and all the supplies that were necessary, we could not, without an overpowering force of 30,000 or 40,000 men, venture to force those passes in the face of large armies such as the Persians have already collected, say 20,000 or 30,000 men; they having the advantage of the ground, and being able to throw up works, would stop any army of the same, or even of greater numbers.

Then, again, we must remember that the Persians are all of one religion — that is quite different from Affghanistan, — and the Persians would all unite against a foreign enemy. There would be, no doubt, some turbulent, dissatisfied spirits who would join us, with the hope of plunder, but they would be of no military assistance to us. We could not depend, as we did in Affghanistan, on the assistance of any large sections of the people. At Candahar, through the whole nine months, from the beginning of the Cabul insurrection to the end of it, although the Affghan tribes rebelled, other sections of the people were entirely in our favour, who furnished us with supplies. Without that assistance we could not have kept possession of the country; and, unless you have some hold upon the people, you cannot feed your army merely by forays and by foraging parties,—you must have some communications with the people of the country of a friendly nature.

Now from all this it will be seen that the Persian war is one of extreme difficulty. Persia can never become a rich, or a producing, or a manufacturing country, but it will doubtless be turned to great account some day or other as a nursery for soldiers. The

Persian, considered as a mere animal, is so very superior to any other Asiatic—to an Indian or a Turk, or even a Russian—that it is impossible to avoid foreseeing that, as any European war becomes developed in the East, the military resources of Persia must be called into action. In fact, it seems that we could not have a more formidable engine of attack and offence launched against India than a Persian army commanded by Russian officers. In the same way, we could not have a more efficient instrument of defence than the same army led by British officers, or by officers acting in our interests. We cannot ignore the existence of Persia—its geographical position prevents that. It is so connected with India, that we must take it into account in regulating our Indian empire; and consequently, in making an election, it must be recollected that it is better for Persia to side with us rather than with Russia, because she must lose all her political influence before she can become the vanguard of a Russian army,—but as an army of defence her independence is an essential element in the defence of India. As I have shown you the extreme difficulty there is in coercing Persia as an enemy, it is to be hoped that she will see her own interest in allowing us to revert to our old policy, which has guided us for forty years, in determining that her strength is our strength, and looking upon Persia as our best bulwark for India against Russia.

Friday, 15th May, 1857.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON THE ARMIES OF ANCIENT GREECE.

BY THE REV. GEORGE ROBERT GLEIG, M.A.,

CHAPLAIN-GENERAL TO THE FORCES.

BEFORE I plunge into the lecture which I have undertaken to deliver, I think it will only be fair both to you and to myself if I state in few words some of the reasons which have induced me to fix your attention to-day upon what some may perhaps consider a very old-world subject. It can be no secret to any one here present that we are on the eve of great changes, and I hope of great improvements, in many points which bear upon the general arrangements of our army. I believe that before long the profession of arms will take its proper place in public estimation—that young men intended for the service will themselves see, and their relatives be taught, that they must exercise their minds as well as their bodies before they enter it; and that officers having received their commissions will be led to perceive that they have undertaken the practice of a great art, which requires as much study as any other art or science with which common men are familiar Now I am not going to give you my own opinion upon any of these matters; but in one point I think you will all agree with me, that the preparatory education of young men intended for the army can no where be better carried on than at our great public schools. You may depend upon it that the moral discipline exercised in these places is of unspeakable benefit to all who go through it, and that even classical learning, though it be so much the habit to undervalue it, lays no bad foundation for that special training which, when he attains to a certain age, I hope every young man intended for the army will hereafter undergo.

Among other subjects, the mastery of which seems to be required from an accomplished soldier, there is one which cannot but be obvious to all—I mean Military History. It is a great mistake to suppose

that only those portions of military history which we find in works of modern date, deserve the attention of the military student. I tell you, on the contrary, that a boy at one of our public schools, if he be under the guidance of a judicious tutor, will find in the Greek and Latin books which he is required to read, not merely the means of acquiring a knowledge of two languages, beautiful in themselves, and lying at the root of all others which are spoken in Europe, but a vast deal of information which he will find useful to him in his after-career. Therefore it is that I propose on the present occasion to talk to you about the constitution, the tactics, and the movements of the armies of the Greeks, and to illustrate my views by describing to you one great military operation. And hereafter, should circumstances enable me to do so, I may possibly go on with the subject, leading you through the Roman armies to the modern armies; for the purpose of shewing you that the principles of the art of war never vary;—that they are the same in all ages and in all countries, though tactics necessarily undergo changes with the changes of arms which the progress of time and invention has brought about.

So much for my introduction.

I dare say that no scholar here present will be surprised when I say that the oldest writer upon military subjects with whom we are acquainted is Homer.

You will observe that, in so expressing myself, I take no part whatever in the controversy which once upon a time taxed so severely the skill and ingenuity of the learned in this and other countries. For it is of very little consequence to the matter now under discussion whether we accept Homer as a veritable man, the son of Chritheis, the blind bard of Smyrna, or look upon him as a mere myth;—an abstraction like our own Ossian, under the shadow of whose name traditionary poems long handed down from one generation to another were at last brought together and connected. In either case there can be no doubt of the great antiquity of the Iliad, to which the best authorities, and among them the Arundelian marbles, assign a date of between eight and nine hundred years before the birth of Christ. It is past dispute that by a countless majority of those who read that glorious epic, either in translation or in the original, little else is

looked for except the imagery with which genius of the highest order can invest any subject with which it has to deal. All beyond, is accepted as a description of the barbarous usages of a barbarous age, when men, going forth to battle, entered into it as Irish factions used to enter into their fights a quarter of a century ago; heaving fragments of rock one at the other, or engaging in savage duels, which never terminated except by the slaughter of one, and sometimes of both the combatants. The few who look deeper into things discover much more than this. They perceive that, so early as eight or nine centuries before the Christian æra, war had become with the Greek nation conspicuously an art. They observe that a number of petty and independent states or clans, all speaking the same language, all descended originally from the same stock and connected by similar institutions, enter into an alliance for the attainment of an object common to the whole; that they elect one chief to command the allied forces, which consist of contingents or divisions, each having its own chief or general at its head; that the several states supply—not men only, but also stores and means of transport, more or less extensive according to ther respective resources; and that the expedition assembles, sails, and makes good its landing in the enemy's country with as much regularity as a year or two ago the combined fleets of France and England passed the Black Sea and disembarked their armed cargoes on the beach near Eupatoria. Reading on, they discover that the first thing done by the invaders is to secure to themselves, in case of a reverse, the means of a safe retreat; that they draw up their vessels along the shore so as to place them out of danger from the sea, and protect them against assaults from the land, by covering them with entrenchments. Meanwhile, with a view to guard against the failure of provisions, not only are foraging parties sent out to sweep in the enemy's cattle, but arrangements are made for the establishment of regular markets, which are to be supplied by vessels appointed to pass to and fro between the camp at the mouth of the Scamander and the sea-ports in the neighbourhood. Again, when military operations begin, the troops are not let loose to shout and struggle like a mob, but the army is marshalled exactly in such order, as, looking to the weapons which the men carried and the nature of the ground over which they were

to move, appears to competent judges of the present day to have been the best that could have been adopted. There was no cavalry then with a Greek army. The art of breaking and managing horses to be ridden was either not yet invented or had made very little progress, at all events in Greece. But chiefs and officers of rank rode to battle in chariots, which they used more frequently to facilitate their movements from place to place than for any other purpose. You know how the Homeric chariots were managed. Two men rode in each—one to guide the horses, the other to fight. When the proper moment to engage arrived, the warrior descended from his chariot and fought on foot. When the weight of his armour or any other circumstance led him to desire rest, he moved towards his chariot, which the charioteer had withdrawn just out of reach of danger to himself and to the horses. And the charioteer, driving quickly up, took him in and went away with him. It is worthy of remark too that charioteer and warrior never changed places. Indeed it was the last order given by Agamemnon before dismissing his chiefs to their respective commands, that this division of labour should on no account be interfered with—that, if a warrior had the misfortune to have his chariot captured or his charioteer killed, he should not pretend to take the reins, but get into any other which seemed to have room for him, and continue the battle as before.

The chariots, however, though presenting a formidable array, were used only by men of rank. The masses were organized into two, and only two, kinds of infantry—one light and irregular, carrying horn-bows, short darts, and slings; the other regular, and heavy—armed with spears. Short swords or knives seem also to have been worn by all, and the spearmen, besides incasing their trunks in armour, carried shields on their left arms. The shields and armour of the chiefs were gorgeous, as the description of that of Achilles shows. The cuirasses of the infantry were mere plates of brass, from which depended a sort of quilted petticoat reaching to the knee. The feet were shod with sandals, and the legs were bare. No Greek helmet had at any time a visor. The light infantry wore no armour except on the head, but were equipped in jerkins and kilts of skin or leather.

In the plain before Troy, the Greek army seems to have moved to

the attack in three lines. The light infantry covered the advance, but retired behind the line of chariots as the opposing armies began to close. This seems to have been done for the two-fold purpose of affording to them some protection while discharging their missiles, and of keeping them from dispersing; for the heavy infantry, with levelled spears, formed the third line. But it is not necessary to go further into these details, on which indeed I have touched for the single purpose of drawing your attention to the fact, that, even from the pages of a Greek poet, the soldier may learn something, which, if he have been, during pupilage, in the hands of a skilful tutor, shall not prove altogether useless to him when studying his profession.

In times long posterior to that of which I am now speaking, when the patriarchal had given way to other forms of government, every freeman in a Greek state, not incapacitated from age or infirmity, was liable to military service. From eighteen to forty all indeed were obliged to serve, when the occasion arose, and all served gratuitously. But in Athens the youth between eighteen and twenty was, like the man who had passed forty, kept at home to guard the city. After twenty he took his part in the campaign. After sixty he might hang up his arms in the temple of Athenæ if he chose, and pass the remainder of his days in peace. The Spartans, as a general rule, were more chary of the health of their young men. They trained them indeed to habits of great endurance, but never, except when hard-pressed, sent them to take part in operations in the field till they had attained the thirtieth year of their age. Both states, as indeed was the case throughout Greece, branded their soldiers in order to hinder them from deserting; but of such brands, as they were impressed on the arm or on the hand, no man was ashamed; they were honourable distinctions. Hence St. Paul's well known expression, "I bear in my body the marks [that is, the brands, stigmata] of the Lord Jesus." They were inflicted upon me to disgrace me; but they are my glory, for they mark me as a soldier even unto death of the sovereign to whom my fealty is pledged. Slaves, on the contrary, were branded on the forehead.

Greece is not a country adapted for cavalry, and it was long before any of the state mounted any portion of its troops. Neither is it accurately known by whom the art of equitation was introduced

among them. The Amazons, the Centaurs, Bellerophon, and Neptune all get credit for having first broken-in horses for the saddle; if indeed it be admissible to speak of saddles in ages when such things had no existence. For the equipments of cavalry among the ancients were extremely rude, down even to the times of Lucan. That writer describes the Massylians of his day, as not only destitute of saddles, but as guiding their horses by the switches or whips which they carried in their hands.

The Numidians of Jugurtha's time, the Lybians, and the Scythians so late as the Roman Empire, had no bridles, but managed their horses by the mere inflexion of their voices. Virgil tells us that the inhabitants of Pelethronium, a town in Thessaly, were the inventors of bridles. Pliny attributes the invention to an individual called Pelethronius. These are mere traditionary tales, with the accuracy of which we are not much concerned. But whoever may be desirous of tracing the progress of equitation in classic Greece will do well to study the subject at the British Museum, where the marbles which adorn the walls will show him graceful figures, some bestriding bare-backed steeds, others seated upon skins. He will observe also that there are no stirrups; for young men long ago were in the habit of leaping from the ground to their horses, or they trained their horses to stoop while they were mounted. For the aged, accommodation was provided by placing stones at convenient intervals along the sides of the roads.

We read in classic authors of war-chariots furnished with scythes at the axle-trees. These were the invention of the barbarians. The Greeks tried, but soon laid them aside, for they proved as dangerous to friend as to foe. If the nerve of the driver failed, or his horses became unmanageable, they were just as apt to dash round and sweep through the ranks behind as to press on, carrying destruction into the ranks in front of them. And so in after-times it fared with elephants and camels,—with the former especially, which, though very formidable when first seen, gradually lost their terrors. They also were used for a while in the Greek, or rather in the Macedonian, armies; but a short experience made manifest the fact, that in battle they could not be depended upon. When wounded or frightened, they ran wildly over the field; and the Greeks, seeing

this, made use of them at last only as we use them in the East, as occasional beasts of burthen. But I am anticipating.

Among all the Greek states, the most warlike throughout, and the first to systematise her military resources, was Sparta. We find her, about five centuries before Christ, mistress of the whole of Laconia, with a territory which is covered on three sides by the sea, and a capital protected on the north by an almost impassable frontier. She owed her military, not less than her civil, constitution to Lycurgus, and it was admirably adapted to the political circumstances of the age. As I have already said, every man from eighteen to sixty was liable to military service. The youth of the various districts and villages were enrolled into *enomoties*, or companies, each consisting of twenty-five, or thirty-two, or thirty-six men. These drilled and practised their military exercises together, under the *enotomarch*, who was promoted to command because of his strength, activity, and skill, and who took his post on the left in the front rank when the company formed line, and moved with the leading file on the march. The line was never less than three, nor more than six deep; and it changed front by wheeling and countermarching, very much as a company or sub-division does among ourselves. It was the nucleus of the whole military system of Sparta—for all the additions made to it were but multiplications of itself. For example, the *pentekostos*, the *lochus*, and the *mora*, were,—the first, two *enomoties;* the second, two or four *pentekosti;* and the third, four or more *lochi;* that is to say, four hundred, six hundred, sometimes nine hundred men. So also, while each *enomoty* had its *enomotarch*, or subaltern, each *pentikostos* had, over and above these subalterns, its *pentikoster*, or captain; each *lochus* its *lochage*, or major; and each *mora*, or battalion, its *polymarch*. From the *polymarch* orders were passed on to the *enotomarch*,—just as among ourselves captains take up the word from officers commanding battalions, and execute battalion movements by rightly handling their companies.

You need not be told that, in civil life, the frame of the young Spartan was systematically hardened by exercise. The drill of the soldier, likewise, consisted almost more in the practice of gymnastics than in anything else. His lance or spear exercise was very simple.

He extended and closed his files according as the necessity of enlarging or contracting the front of the line presented itself; and he was trained to march in cadence to the sound of a flute, which in war as well as in peace modulated his tread. The other states of Greece did not attain to anything like the same regularity till much later; and, as they proved to be little more than mere copyists from the Spartans, I should but repeat what I have said already were I to speak of them in detail.

A Spartan army was always commanded in the field by the king —or, in the event of his non-age or incapacity, by a lieutenant chosen to act for him. In Athens, where troops were raised by tribes, each tribe furnished its own general, and all the generals were possessed of the same degree of authority. Now, as there were ten tribes—and, therefore, ten generals, this was prone to lead to vacillation and difficulty—for only in councils of war could operations be decided upon. It not unfrequently happened that votes were equal, till at last a *polymarch*, or President of the Board of General Officers, was chosen, who, in cases of this sort, gave the casting vote, and assumed absolute authority over the rest. Such was the conduct of Miltiades in that hour of peril, when the hosts of Darius swarmed upon the Greek shore, and the battle of Marathon, with the rapid march back to Athens at its close, saved Europe from the barbarism with which it was threatened.

Till Greece came into hostile collision with Persia, the wars of her various states were upon the smallest possible scale. Argos, for example, quarrelled with Corinth, or Sparta fell out with her next neighbour—and the army of the one invaded the territories of the other, burning villages, laying waste fields, and fighting battles, when the forces from either side met. This was their summer's occupation, at which season, under a genial climate, there was no great hardship in sleeping out; and it does not appear that their longest marches ever carried the troops more than forty or sixty miles from home. In winter the armies broke up, the men returning to their villages and cities. The preparations for a campaign of this sort were of the simplest kind; no commissariat was organised, because none was necessary, but each soldier, carrying with him a few days' provisions, was ready for whatever might befal. A little

salted meat, cheese, olives, onions, and dried fruit constituted the food of the soldier during the campaign. These he bestowed in a casket of wicker-work, in other words in a basket, which he slung at his back. The basket had a peculiar shaped mouth, and was called the *gulion*—whence men with very long necks got the nickname of *gulionchenes*.

Time passed—and, by a process which is visible in all parts of the world where small states adjoin, Sparta and Athens gradually overshadowed their neighbours, and became rivals in the arts both of peace and war. Sparta continued to the last a strictly military nation. Athens became more a naval than a military power; yet she by no means neglected her army. On the contrary, an Athenian officer proves to be the first great military reformer, prior to the appearance of the Macedonians on the stage. About the year B.C. 390, Iphicrates addressed himself to remedy the defects which up to his time had been apparent in the equipment and evolutions of light troops. Heretofore these people, indifferently drilled, and armed only with knives, short darts, and bows, served rather to distract and annoy than seriously to check or restrain the well-disciplined battalions to which they were opposed. For they were collected in a hurry, and let loose upon the enemy with such weapons and appointments as happened to be available for their peaceful occupation as shepherds. Iphicrates took them in hand, lengthened both their javelins and swords, of which he stored up supplies for them in the city, and protected their legs from scratches and bruises by casing them in leathern leggings.

Gentlemen, it is curious to observe how, in small things as well as in great, the customs of society go round in a circle. We had, some years ago—we still, I believe, have in use among us—boots named after two illustrious commanders, Wellington and Blucher. In Athens, for many days after the time of Iphicrates, leathern leggings were known as *Iphicratides*.

It is not necessary that I should speak of the causes which led to the alternate wars and alliances which connected Greece with the Persian empire, and ended at last in the overthrow of the latter. The Greeks, straitened at home for room, and much addicted to commerce as well as piracy, settled colonies, as you are aware, at a

very early date, along the shores of Asia Minor, which, supported by the mother-country, maintained through many ages an uneasy independence upon the larger states and provinces which surrounded them. This became a hard task to achieve, after Persia, under the successors of the great Cyrus, had absorbed the vast empires of Babylon and Egypt; and that of Sardis would not have been accomplished at all, had not Athens and Sparta, but especially the former, entered freely into the struggle. Indeed, it was as much by policy as by war that the colonies held their own at all, for they not unfrequently kept the conqueror at a distance by paying tribute, and supplying him, as allies, with troops, which he found of extreme value to him in his operations elsewhere. It was this intercourse with Persia which led to the raising in Greece of corps of cavalry, which seem at first to have been universally equipped with helmets and cuirasses, and to have carried, as offensive weapons, darts and crooked swords. They were divided, like the infantry, into troops and squadrons, and had generals of the special arm placed over them, who, however, took their general orders, as among ourselves, from the *strategos*, or commander-in-chief. But we will, if you please, pass lightly over what may be called the transition state of the Greek armies. If you desire to satisfy yourselves as to what they had become, and what they were able to effect, and did effect, ere yet, under Philip of Macedon and his son Alexander, they had attained the perfection of their organisation—read the history of the Peloponnesian war, as Thucydides has recorded it, and the Anabasis, or Retreat of the Ten Thousand, by Xenophon. Read these narratives, too, not for the mere sake of storing your minds with the knowledge of things passed, but that you may learn lessons which, should it fall to the lot of any of you at any time to command armies, may prove of the greatest possible use to you in the hour of need. For I do not hesitate, even in this presence, to give it as my opinion, that nowhere in military history are more instructive lessons to be learned in the art of war, than in the simple and intelligible story of the movements of the force which, after the fall of Clearchus, came under the guidance of Xenophon, and marched and fought its way from the Zab to Trapesus or Trebizond.

The Peloponnesian war, in its results, broke the strength of Greece. It produced, indeed, its heroes and its statesmen—Tolmides, Simon, Archidamus, and, above all, Pericles, the very model of a wise commander, whose speeches, as Thucydides has preserved them, cannot be too much studied, either by the soldier or the politician. But it ruined Athens, and left Sparta dizzy; while, to the north of both, a people was growing into power, of whom as yet little note had been taken. I refer to the Macedonians—a mixture of Greeks and barbarians—whose history is too much mixed up with that of the surrounding tribes to admit of analysis here; and which the most painstaking writers find it no easy matter to give, except with a perplexity of order which sorely tries the patience of their readers. For, the moment we touch them, we find ourselves compelled to notice Thracians, Illyrians, Thessalians, and many more, to speak of whom, without a carefully executed map before us, would involve us in a perfect labyrinth of words. It will be sufficient, therefore, for our general purpose, to state, that Macedonia proper seems to have been early occupied by a colony of Argives; that by virtue of their descent from the leaders of that colony, Philip, and Alexander, his illustrious son, claimed to be regarded as Greeks; and that, for many generations before the birth of the former, we find Macedon mixed up with Greek affairs, sometimes as an ally, sometimes as an enemy, and still more frequently as a bone of contention. Let us take a rapid glance at its condition, when Philip had established his sovereignty over it; and contrast that with the state of Greece, and especially of Athens and of Sparta, as their fatal intestine strifes had produced it.

The Athenian and Spartan citizens of 430 years B.C. were ever ready to brave danger for their country's good. They served her as soldiers without pay, and served her nobly. The Athenian, and, though to a less extent perhaps, the Spartan citizen of 360 B.C., had entirely changed his nature. He loved ease and the pursuits of literature and philosophy, and staid at home, trusting the honour and defence of his country to hired mercenaries. These were gathered in from every state throughout the federation; and, like the Condottieri of the middle ages, were ready to transfer their allegiance from one paymaster to another as often as occasion re-

quired. The Ten Thousand, of whose exploits I have elsewhere spoken, partook in some degree of this character, for they were tempted into the service of Cyrus the Persian by the offer of large pay in the meanwhile, and the promise of preferment after he should have dethroned his brother. Philip, on the other hand, found himself sovereign of a people rude, brave, hardy, prompt for war, but destitute of military organization. Himself endowed with military genius of the highest order, he set about remedying this latter defect; and, notwithstanding the pressure of constant war with his neighbours, he accomplished his purpose. Heretofore, the force of the country had consisted either of mounted men — substantial landed proprietors, who took the field incased in coats of mail, and armed with swords or spears, as the case might be—or of the rural population, shepherds and herdsmen, who carried wicker shields, old swords, slings, bows and arrows, and occasionally, not often, short lances. The towns on the sea-coasts—having been peopled many of them by Greek colonists—could muster their trained bands, whom they equipped, like the Hoplitæ of Athens, with spears, but these were few in number; and everywhere else foot-service, being accounted little honourable, was taken up only by the poorest of the people.

Philip entirely revolutionised this state of things. He enrolled the poor and hardy Macedonian landwehr into sections, companies and battalions, brigades and divisions, and, by the armament which he gave them, rendered them superior even to the Greek Hoplitæ. These latter, you will recollect, carried pikes sixteen feet in length, which they wielded with the right hand, while on the left arm hung a square and heavy shield. Philip equipped his heavy infantry with pikes, measuring not less than 21 feet in length, which they were trained to wield with both hands, and which, on ground fitted for their use, proved irresistible. The defensive arms of the *phalangite* consisted of a light circular shield, about two feet in diameter; of a breast-piece, leggings of tin, and a broad-brimmed hat, called the *causia*. A man so equipped could of course do little acting singly,—a dense column of such men, on open ground, could scarcely be broken. It is worthy of remark, that each phalangite wore also a short sword.

The telling-off of the Phalanx appears to have differed very little from that of the heavy infantry of Athens and Sparta. The *lochus* in Macedon mustered 16 men; the *syntagma*, 16 lochi, or 256 men; the *pentekosiarchy*, of 2 lochi, or 512 men. This latter represents a battalion, of which the strength was doubled by Alexander, when he reorganised his army at Suza. But the entire tactics of the force depended upon the unit whence it sprang. On the march, the column increased or contracted its front so as to adapt itself to the width of the road. It could form for battle only on an open space, and then it stood in a line of sixteen deep. The five front ranks levelled their spears; the three next interlaced theirs over the shoulders of the ranks in front of them; the eight in rear stood with shouldered pikes, prepared either to give the weight of their pressure to the advance, or to face about and meet danger, should it threaten from behind. When the hour of trial came, the Greek hoplitæ, with all their courage, found the sixteen-foot lance useless, when opposed to the Macedonian pike—the formidable *sarissa*.

An army composed exclusively of phalangi would, however, have proved unwieldy; so Philip supplied what was wanting, by adding to it two sorts of infantry besides, and two sorts of cavalry. The supplementary infantry consisted, first, of regiments of *hypaspists*, who carried one-handed pikes and shields, like the Greeks; and, next, of light troops—bow-men, slingers, javelin-men—all carefully drilled to skirmish, and inured to the severest exercise. His cavalry were either heavy or light. The heavy wore coats of mail, and brass or tin leggings. Their weapon of attack was the *xyston*, or short thrusting-pike, and the sword. The light cavalry carried lances, about sixteen feet long, and, like the Cossacks of modern Russia, were employed chiefly at the outposts, or to scour the country. The organisation of both was as perfect as that of the infantry, and started from the same unit, viz. the *lochus*. The squadron appears to have numbered sometimes 180, sometimes 250, horses.

A Macedonian army, thus arranged, proved, under Philip's guidance, irresistible. But Philip's wars, like those of the Athenians and Macedonians, were, comparatively speaking, on a small scale;

and hence, though we discover the beginnings of other and not less important arrangements in his military system, we must look to the reign of his successor in order to satisfy ourselves fully as to their nature and extent.

When Alexander came to the throne, he found a school established for the training of officers, which he enlarged and perfected. The sons of the chief men of the country came to the capital as soon as they had reached military age, and were taken into the personal service of the king. They discharged the duties of page, gentleman-usher, and master of the ceremonies. They mounted guard over the palace. They had the ablest masters to instruct them in the arts, and especially in the art of war. They rode with the king when he went hunting, and formed his body-guard in war. He was accustomed to employ them one by one on services the most delicate as well as the most hazardous; and, according as they acquitted themselves to his satisfaction, they were promoted.

Philip had raised Pella from the rank of an obscure town to that of a first-rate city. Here stood the war-office, with its staff of administration, working at least as busily as the gentlemen in Pall Mall, and at the Horse Guards. Here were the great arsenals, wherein arms, carriages, and wagons were fabricated, and everything necessary to render an army efficient in the field stored up and ready to be issued. The barracks were commodious and extensive, with drill-grounds, and spaces for training convenient to them. Into these, recruits were introduced as they came up from the country —cavalry on one side of the arsenal, infantry on the other. They were instructed in their duty as members of depôt battalions, and thence sent off by draughts to fill up vacancies in the ranks that were in the field. Moreover, Philip had begun, and Alexander perfected, a complete ordnance corps. He had not only his battering rams, but ballistæ and other engines for throwing stones and darts; some heavy, and therefore suitable for siege purposes; others light, which accompanied cavalry and infantry into the field. Besides all these, he had his land-transport corps, with its train of carts, pack-horses, and beasts of burden, over which military officers presided. In a word, Macedon had been rendered by Philip some-

thing very like a large camp. Alexander took it over in this condition, and rendered perfect whatever his father had left even slightly incomplete. But it was not upon the resources of his own country alone that this extraordinary man relied. Greece stood towards him very much in the relation in which the Confederation of the Rhine stood, in 1811, towards the first Napoleon. Though nominally independent, the states supplied him with troops when required, and adopted his policy both in peace and war, however distasteful to their feelings might be the tone in which they were expressed.

Let us content ourselves with a brief glance at the early career of Alexander. He found himself, on acceding to the throne, the heir of a policy which suited well with his adventurous character. His father had begun to make preparations for the invasion of Persia, and he determined to go on with it. But difficulties met him. Greece, instigated by Persia, and herself impatient under the yoke, endeavoured to free herself from her Macedonian connection. Thrace, Illyria, Thebes, openly rebelled. He overcame all the opposition; he crossed Mount Hæmus, defeated the Triballi, passed the Danube, overthrew the Getæ, carried Thebes by assault, and completely overawed Athens. It is in one of these campaigns,—in his operations against the Illyrians, that we find him for the first time making use of his siege train; driving the defenders of a town from the parapets, with stones and darts, and assailing the walls with his battering rams. But more important operations had been determined upon, and for these the mistaken contempt of his youth, entertained by Darius king of Persia, enabled him at his leisure to make ready.

It was in the winter of 335-334 B.C., that Alexander made his final preparations. His grand depôt he of course established at Pella, the situation of which was admirable, on two rivers, both navigable for light craft, and within fifteen miles of the Ægean. He appointed 12,000 regular infantry, with 1,500 cavalry, under one of his best officers, to overawe Greece during his absence, and to guard the coast from descents on the part of the enemy. He selected to follow him on his great expedition only 30,000 infantry and 4,500 cavalry;—

wisely considering that mere numbers do not constitute the strength of armies, which ought always to be proportioned to their probable means of subsistence. But his troops were complete in everything that tends to render an army efficient, and a fleet of 160 triremes, with many vessels of smaller size, prepared to move parallel with them as long as circumstances would allow; for he had wisely determined to move by the coast road. How Darius came to overlook or neglect these preparations, warned as he had been by his Greek general Memnon, it is difficult for us to conceive. He was immeasurably superior to Alexander by sea, having the whole Phœnician fleet at his disposal. He might have blocked up the Hellespont and swept the Ægean had he been so disposed, and the entire coast-line both of Macedon and Greece lay open to perpetual attacks and alarms, against which Alexander's army of reserve could have offered but ineffectual opposition. But there was jealousy between his Greek and Persian officers, which produced its customary results. The foreigners were suspected of seeking ends of their own, and the more cautious policy of the natives was adopted.

Alexander distributed his 30,000 infantry into six divisions, or taxeis, adopting in this respect an organisation almost identical with our own. His cavalry he distributed into four brigades, of which the light or lancer-brigade numbered 900 horses. The rest made up two heavy brigades and a corps of Greek auxiliaries. I cannot quite make out whether at this stage of his career he had established a bridge equipment. I am strongly inclined to believe that he must have done so, because he had several rivers to cross ere the campaign could be opened, which would probably require bridging. However this may be, it is certain that at a later date a bridge-train attended upon all his movements. Read Arrian's account of his advance upon India, and if any doubts upon this matter should have rested upon your minds, they will at once be dispelled. Alexander moved upon the Hydaspes, carrying with him light vessels mounted upon carriages, which, for the sake of convenience upon the march, were divided, some into two, others into three pieces. Now what were these vessels but pontoons? When he approached the banks of the river, he halted the carriages under the screen of a thick wood, put

the vessels together and launched them raft-wise—pretty much as our own engineers launch their pontoon-bridges on the waters of the Medway, or wherever else they may be called upon to make rivers passable for troops. In like manner Alexander's engines for throwing stones and darts took their places on the flanks of columns, or in the intervals between one brigade and another, where the nature of the country would not admit of parallel movements. His battering rams, wagons, and baggage-horses marched in the rear of his columns on the advance—in their front, if he was practising a retreat. And besides that, the drivers were all armed; a regular guard protected them. Will any body say that lessons in the art of war are not to be learnt from the history of men and of times which seem to have left no point that is necessary to the organisation and management of armies unattended to, which provided not only for the maintenance and support of forces in the field, but cared for all necessary means of supply—in their recruiting—in their treatment of recruits—in their wise establishment of depôts and magazines—in the staff of officials which they kept to manage the accounts of the army, and held personally responsible for the due performance of the duties which the government had assigned to each—which had their military records carefully preserved, and books illustrative of tactics and strategy elaborately compiled? But we will return to Alexander.

Having completed his operations both for offensive and defensive war, Alexander began his march from Pella. He moved leisurely, in order that there might be time for the fleet to meet him at the mouth of the Hellespont. He made a brief halt at Amphipolis, establishing his head quarters in the town. He arrived next at Abdera, and there passed the river Nestus. He then entered Thrace, crossed the Hebrus and Melas, and traversing the Chersonese arrived at Sestos. The Strymon, the Nestus, the Hebrus, and the Melas are none of them very large rivers; but, as Alexander moved with carriages of various kinds, and as the banks of some of them are steep, we may fairly assume, that if he did not find them bridged he bridged them.

The Macedonian fleet had already arrived at Sestos, and the troops were commanded to embark forthwith. While this was doing,

Alexander paid his well-known visit to the site of Old Ilium. He accomplished this feat, so to speak, alone; crossing the strait in the admiral's trireme, which he steered with his own hand. He was ambitious to be the first of the Macedonian host to tread the Asiatic shore, and he succeeded. But, though full of romance, he was, at the same time, one of the most far-sighted and sagacious generals that ever lived. Having offered his sacrifices, as a hero, to the manes of the dead, he hurried back to Abydos, where his army had begun to assemble, that he might resume the occupations of a great commander. Here a grand review took place, at the close of which the army was distributed into two wings or columns. Of the right column, Alexander himself took command; the left he placed under the immediate orders of his friend Parmenio. The muster-roll showed that the army was thus composed: Of the Macedonians, partly Phalangi, partly Hypaspists, there were present under arms 12,000. Of Greek allies, armed and equipped like the Hypaspists, 7,000. Of mercenaries, 5,000. All these were fit for close combat. The light troops, chiefly Triballi and Illyrians, armed with slings, darts, and short spears, mustered 5,000, and there were 1,000 archers. Of cavalry, two brigades were heavy Macedonian horse, each 1,500 strong. Two others, one of Grecian horse, 600, the other of Thracians and Pæonians, 900. The most perfect gradations in the order of command prevailed everywhere.

Meanwhile the Persians had not been wholly regardless of the storm which threatened. They declined indeed to be guided by the counsels of Memnon the Greek, and so threw away their superiority by sea; but, under Arsytes, a Phrygian satrap, they collected a considerable army at a place called Zeleia and waited the issue of events. They were greatly superior to Alexander in cavalry, which the lowest estimate puts down at 20,000. And Memnon, who served under Arsytes, strongly urged that advantage should be taken of this circumstance. He recommended his chief to avoid a general action, to retire before Alexander, laying waste the country as he went; to beat up the Macedonian out-posts, harrass their convoys, and strike at their baggage; and to attempt more serious diversions from the sea by landing in Macedon, and compelling Alexander to

return for the defence of his own country. But Arsytes was the civil governor, or pasha, of the district. His personal assets depended on the amount of produce which it reared, and he refused to sacrifice his own resources for the sake of the empire. He accordingly advanced to the Granicus, along the right bank of which he took post. Here he determined to give battle, having, as Arrian states, under his command 20,000 excellent horse, and 20,000 or 25,000 good infantry, all of them mercenaries, chiefly Greeks.

The Granicus, though famous in story—first because it is commemorated in the Iliad, and next as the scene of the battle which I am going to describe—is an inconsiderable stream. It takes its rise in Mount Ida, and flows northward into the Propontis, or Sea of Marmora. It is fordable in many places; but the right bank is steep, and therefore offered considerable advantages to the force by which it was that day occupied. It was to cover these fords that the Persians drew up with their left resting upon the declivities of Mount Ida and their right *en l'air*.

Alexander having reviewed his troops at Abydos, rested there that night, and at an early hour next morning began his march. His scouts had made him aware of the proximity of the enemy; he therefore moved with caution, and slowly. He halted the first day at a place called Perkote; the next beside the little river Praktius, and the third at Hermotus. Clouds of light cavalry covered his movements, which he supported with heavy horse in the proportion of one squadron of cuirassiers to four of lancers. His last march from Hermotus to the Granicus he performed in perfect readiness to engage on the first alarm. He appears to have come in sight of the Granicus about two in the afternoon. Parmenio, desirous that the troops should enter fresh into battle, advised a halt till next morning. But Alexander, satisfied that a general action was all in his favour, and against the Persians, refused to listen to the advice. He was apprehensive that the enemy might withdraw from their position in the night, and resolved to deliver battle immediately.

Now observe the skill with which his dispositions are made. While he is arranging his columns of attack, archers, supported by

light horse, push on to the river, skirmish with the enemy, and try the fords. An attempt is also made to clear the opposite bank by shooting stones and darts from ballistæ, and so far succeeds that the Persian cavalry fall back behind the shelter of the high ground of which they are masters. Meanwhile, the Macedonian army forms: the Phalangi take post by double battalions, each 1000 strong, in the centre, keeping an interval between each double battalion. The Hypaspists, or lighter infantry, form to the right and left of the Phalangi, somewhat in advance. These are flanked by the light cavalry or lancers, supported by squadrons of heavy horse; and on the right of the whole line, opposite the principal ford, is the mass of the heavy cavalry. The light infantry, consisting of slingers, bowmen, and javelin men, extend up towards the base of Mount Ida and threaten the enemy's left.

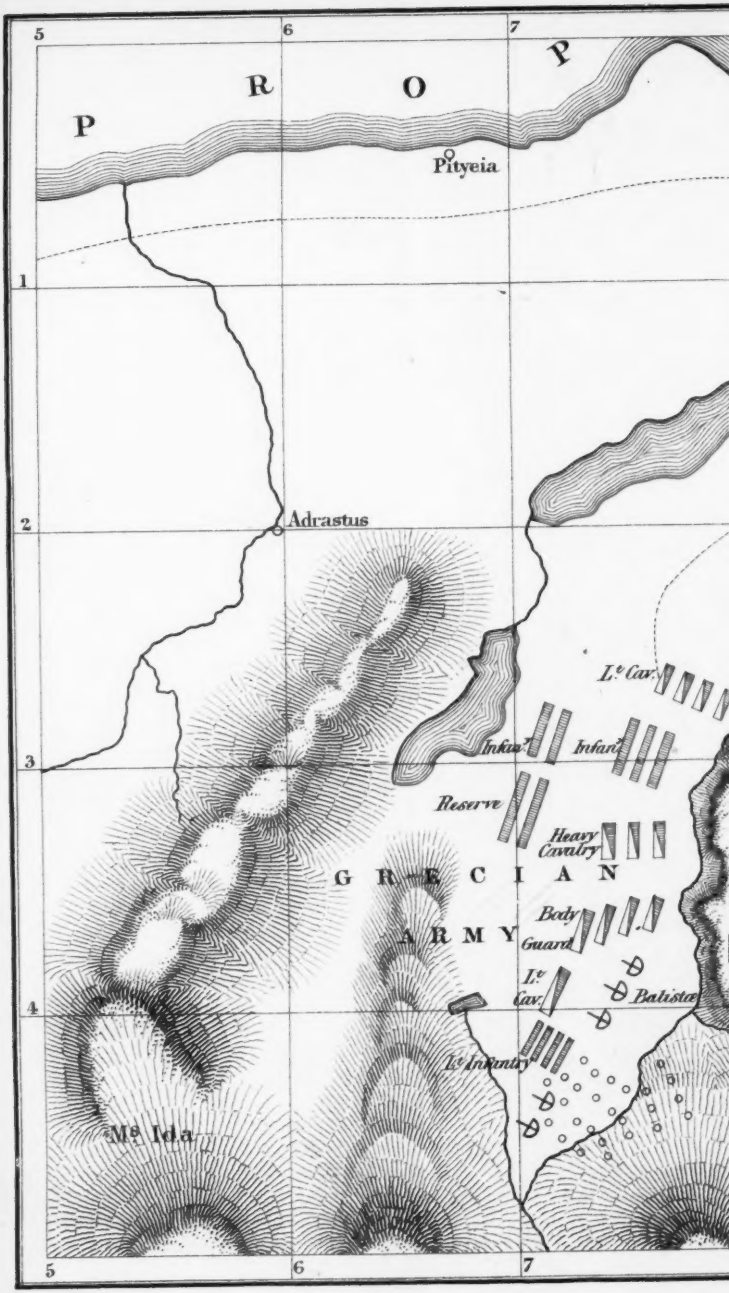
It is not necessary to describe the battle or to speak of its results. The country was open, and there was no smoke, as among us, to confound the vision. All these formations were therefore clearly seen by the Persians; and the Persian horse, as soon as the Macedonians began to move, closed up to their own front again and stood ready to receive the shock. It was given by Alexander's heavy horse, a squadron of his body-guard leading, which the light cavalry or lancers supported, and beside whom, and therefore sheltered in some degree from the force of the current, a division of Hypaspists pushed forward. The resistance was very determined—so great indeed that for a while no man could succeed in forcing his way up the bank—for Memnon was there with the flower of the Persian cavalry, of which a portion rode down to meet the Macedonians in the water, while the rest plied them with javelins from the heights above. But all this while the Macedonian slingers and bowmen were pushing round among the rocks of Mount Ida; and by and by volleys of stones and arrows fell upon the Persians who covered the nearest ford. Then Alexander himself plunged in at the head of a second squadron of the body guard. Then by sheer strength of man and horse the Persians were pushed aside, and steady, yet rapid, the phalanx descended into the river, crossed, and made the opposite bank its own.

The Persian horse was repulsed; but it was still numerous; and

there were 20,000 excellent infantry in line, which had suffered no loss. Against these, Alexander at once led his whole strength. While the phalanx took them in front, the cuirassiers fell upon their flanks, and entirely routed them; for the lancers and Greek allies sufficed to keep the Persian cavalry from rallying. And here was manifested the immeasurable superiority in an open plain of the Macedonian two-handed pike over the one-handed lance of the Greeks. The Greek line could make no impression whatever upon the dense forest of pikes which breasted it; and the slaughter which ensued, when the Hoplyti broke and endeavoured to flee, was terrible.

Alexander's loss was computed at about 1,200 killed and wounded. It is said that of the Persian infantry scarce 2,000 escaped. The speed of their horses carried the mass of their cavalry out of danger.

Such is the page of military history which I proposed to unroll for your consideration to-day. I think that it is wanting neither in interest nor in substantial value. It shows that war has been treated as an art, not by moderns only; that there are other fountains whereat the military student may drink, with refreshment to himself, besides the despatches of the Duke of Wellington and the Commentaries of Jomini and of the Arch-duke Charles. And hence that he who recommends the foundations of a profession to be laid on a broader base than any cramming-school can furnish proposes to the youths who may be ambitious of achieving military renown no useless labour.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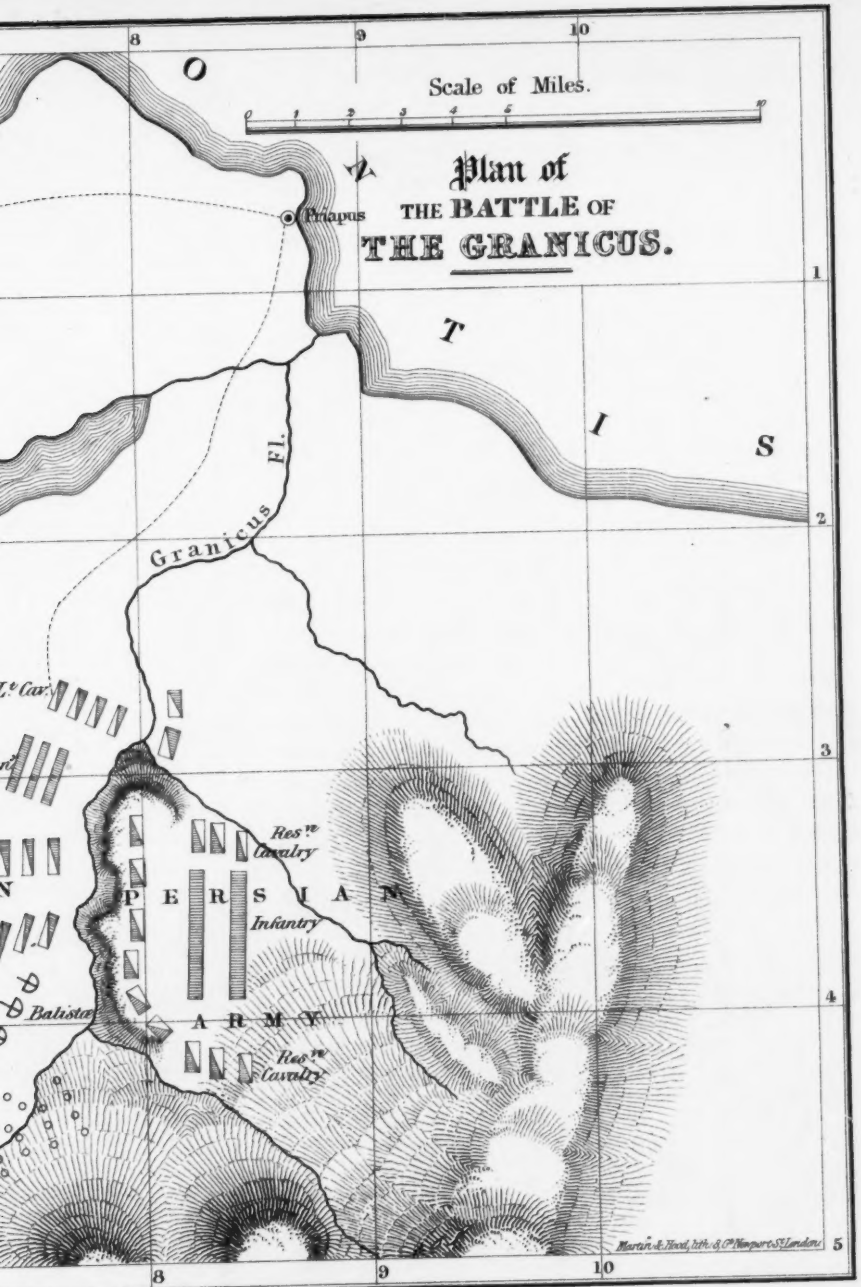
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Balistæ
Martin & Hood, 11th & 12th Newport St. London.
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May 22nd and June 5th.

COLONEL THE HONOURABLE JAMES LINDSAY in the Chair.

ON CHINA AND THE CHINESE.

BY J. CRAWFURD, ESQ., F.R.S.

(*Abstract.*)

IN these two very valuable lectures, the parts most important to the members of the Institution are those upon which Mr. Crawfurd is most competent to speak: namely, first—the character of the emigrant portion of the Chinese population; and secondly—the war and the negociations which are now being carried on.

Mr. Crawfurd, from having had charge of the civil administration of Singapore, from 1823 to 1825, and from the connection which he has since maintained with that colony, has, by personal contact with these people, had more than ordinary opportunities of judging of them; while his previous position as Resident at the Court of the Sultan of Java, and the works which he has published upon the history and geography of the Eastern and Indian Archipelago, entitle his opinions to weight, with reference to any operations that may be conducted in that quarter of the globe.

Mr. Crawfurd, after describing the boundaries of China, and its dependencies, the latter of which, although three times the extent of China Proper, do not contain as many inhabitants as the smallest of its eighteen provinces—pointed out that the grand features of the physical geography of China are its two great rivers, and the vast and fertile plains through which they flow. These rivers, which flow from west to east, are, respectively, thirteen and a half and fifteen and a half times larger than the Thames; and, in fact, it is these, with their branches and tributaries, that have created the great civilization and population of China.

The climate varies, from that of Central Italy to that of Jamaica: in the north, producing wheat and all the products of temperate

Europe; in the south, rice, the sugar-cane, and the productions of the tropics. China, also, possesses great mineral wealth—coal, iron, copper, tin, zinc, lead, mercury, gold, and silver. Of the latter, the quantity must be great, since, until lately, it has supplied the chief consumption of the country itself, and has been often exported. China, in fact, has within itself such a variety of mineral, vegetable, and animal wealth, that, if any country can be said to be independent of others, it is so. This is the view which the Chinese themselves are fond of taking of their country; and, isolated and remote as they are from the more civilised world, their very position in a great measure accounts for their extravagant and irrational national conceit and undervaluing of strangers.

The population is estimated at 360 millions—a number which, spread over the vast surface of China, gives no more than 277 inhabitants to the square mile, probably about 23 less than the present relative population of the United Kingdom. Some of the provinces —those to the north and west—are even scantily inhabited, while the central and eastern provinces, enjoying the benefits of the navigation and irrigation of the great rivers, their tributaries and branches, are very densely peopled. In these portions of China, the land cannot sufficiently feed its own inhabitants, and many of the poorer classes are consequently always in a state verging on starvation. This has given rise to an emigration which has now been going on to a greater or less degree for the last 300 years, but which has never been so rife as at the present moment. By the laws of China, emigration is prohibited; but this law, like a hundred others, is set at defiance, by necessity or corruption. All those who emigrate, are of the working classes, men in the prime of life—for no capitalist ever quits China for a foreign country; and, although each in quitting his native country does so to seek his fortune, and when he has made it to return, yet few attain this end. This accounts for their leaving their families behind them, the motive, no doubt, being the known attachment of the Chinese to the tombs of their forefathers. In this respect the Chinese emigration differs from the emigrations of all European nations. The Chinese emigrants, however, intermarry with the people among whom they settle or sojourn, and the result is a mixed or half-caste population

far more numerous than the China-born. To the credit of the Chinese, it should be observed, that they treat their wives well, and that, consequently, the women of these countries prefer them to their own countrymen. "They work for us," they say, "while our own countrymen are idle and make us do all the work." This mixed race, to whom belong most of the wealthy merchants of the European possessions, although somewhat less industrious, perhaps, than the Chinese, are better informed, and more docile. In the more recently-formed European possessions, the disproportion of the sexes is a great evil—in Singapore, for instance, there are at least ten men for every woman. In all the countries in which the Chinese are settled, it is conjectured that their number may be a million and a half, and in their employments they embrace the whole field of useful labour. They are found as merchants, shop-keepers, artizans, agriculturists, day-labourers, bankers, contractors, &c. In the Dutch and English possessions they are the sole farmers of the public revenue, no other class of the inhabitants, not even the Europeans, being able to compete with them.

Some fears have lately been entertained of the Chinese settlers in our possessions, lest, following the example of the people of Canton, or of the insurgents of Nankin, they might rise against us. These fears, however, Mr. Crawfurd believes to be wholly imaginary. We have had Chinese subjects for nearly a century and a half, and they have neither plotted nor risen against us. The greater number are peaceable, respectable, and industrious; men much devoted to the pursuits of industry, and very little to the pursuit of politics. The majority, too, being born in the country—that is, consisting not of pure Chinese, but of the mixed race—have little connection with China, except in so far as they respect it as the land of their fore-fathers. Our conduct has been fair and just towards them; they pay the same taxes as ourselves, and no others; they are governed by the same laws as ourselves, that is, by the laws of England, except in the matter of inheritance, in which they are governed by their own. They sit on grand and petty juries, and some of their chiefs are even in the commission of the peace.

In the parent country, however, the Chinese, as a race, are a homogeneous people; the same from one end of the country to the

other. They differ in physical form from all their neighbours, even from the Tartars, whom they most resemble. Even the mountaineers of some of the western provinces, who have not adopted the religions or manners of China, nor submitted to her authority, are, in race, the same people; and, although in the eighteen or rather fifteen provinces into which the empire is divided there are considerable differences both in manners and language, yet these are not such as to affect that homogeneity which belongs to the whole people. Moreover, although each province has its own language, or at least its own dialect, there is a metropolitan—called by the Europeans the Mandarin, language, which, more cultivated than the rest, is in frequent use as a general medium of communication. It plays the same part that French does in Europe, Hindi in Hindostan, and Malay throughout the Indian Archipelago. The Chinese may be called a stereotyped people; they appear to have made a certain and large advance in civilization and then to have stood quite still. The arts even, in China, are generally quite stationary; their paper continues to be made from the fibres of the bamboo, and is a brittle, perishable article, inferior to any European paper, and commendable only for its cheapness. The Chinese invented printing 900 years ago, but have never gone further than stereotyping from wooden blocks, and know nothing of metallic or moveable types. They invented the compass, but never applied it to navigation. They discovered gunpowder, but confined it to the manufacture of fire-works. Its use for propelling missiles through a tube they acquired indirectly from Europe. They have now been acquainted with it in war for probably 500 years, but are less expert in the use of fire-arms than any other considerable nation of Asia, preferring their ancient bows, from which they shoot harmless arrows in the face of round and grape shot from 32-pounders. They invented silk some 3000 years ago, and their raw silk is far excelled by that of France and Italy, while in the manufactured article they are beaten by France and England. They were the inventors of porcelain, and are excelled by France, Germany, and England; their ware being now brought to Europe merely as a curiosity. They have preserved their superiority in nothing but tea. Their ships, or junks, are of the same form and equipment as those in which

Marco Polo sailed from the coast of China to the Persian Gulf in 1295, a voyage which it took eighteen months to perform.

Mr. Crawfurd then entered largely into the statistics of trade; questions which, from being imperfectly understood by the people of both countries, have produced sources of irritation between advancing civilization on the one hand and a people thus constituted on the other, and which, of late years, have led to open ruptures. For the balance of our trade, that is, for the difference between the value of our exports and our imports, we pay the Chinese in silver, which is their current money, as it is of the whole eastern world. This balance amounts at the present moment, for India and China—the larger part being for the latter—to a sum not falling much short of twelve millions annually: and there are some among us who look upon this vast export of the precious metals with alarm, as though it were a drain upon our wealth; but it is no more a drain than is our export of iron, or cotton, or woollens. We export silver, because, in a mercantile sense, we do not want it at home—just as we send abroad our surplus produce in ordinary manufactures. The silver would not only be of no use to us, if we could keep it, which is impossible, but the sole effect of retaining it would be to increase enormously the nominal price of every other commodity, and thus to cut us off from all intercourse with other nations. When India and China are saturated with silver, they will take no more; and when they have more than they want, they will begin to export. China did so down to 1851—every year exporting to the value of £2,000,000; but then, no wiser than some among ourselves, she believed that this export of the precious metals was a drain upon her wealth, and, therefore, fulminated proclamations and edicts against opium and the opium-trade, which she believed to be the cause of it, and thus arose the first or opium war. But in all her proclamations and edicts against the opium trade, says Mr. Crawfurd, she never once spoke of its immorality, or of the injury which opium did to health. They called it "black dirt;" and said that by means of this foreign "black dirt" we were robbing them of their gold and silver. The precious metals were "leaking out," that was their expression, and nothing coming in but "black dirt;" and if this went on, they added, the Chinese would soon be reduced to the same state of poverty, as that

to which Europeans had, by means of the same "black dirt," reduced the black barbarians of Java and other countries. They thought, and still think, that gold and silver alone constitute wealth, as we ourselves did, and some of us do to this day. They thought, in short, as we did—that there was a signal advantage in possessing more pots and pans than there was food to cook—an illustration of Adam Smith. Previous to these precious edicts against opium, gold and silver had been yearly imported into China; but, the importation of opium having greatly increased after the overthrow of the tea monopoly, the balance was turned against China, and gold and silver came to be exported. For the last seven years, the balance has again been in favour of China, and gold and silver have been largely imported; and since then the Chinese do not consider themselves as being robbed, and not a word is said about the "black dirt." On the contrary, the importation of the drug is as free as that of cotton or iron; and the Chinese themselves are cultivating the poppy and producing a large quantity of opium, although the article turns out to be inferior in quality to that of India.

The present war, or more properly speaking our present quarrel, with China has more of a local than of an imperial character. It has been in progress from October to April, and, although the trade and revenue of Canton have been destroyed, and the second town in the empire blockaded, the Imperial Government, as far as we know, has not taken the least notice of it. We are at open war with Canton; but the other four ports have not entered into the quarrel, and our trade with them goes on only the more briskly that there is no trade at all with the sister port. Even when we attack, capture, and occupy Canton, which we must do, its capture and occupation will have no sensible effect upon the Imperial Government. The other ports will take no heed, and we shall want neither tea nor raw silk.

What then will be the effect of the military operations which are now being directed against this people? They are essentially unwarlike, and have no taste for war, or any employment that has even the semblance of it. They look upon war as an idle and profitless employment. "I once tried them," says Mr. Crawfurd, "as a constabulary force, and the failure was complete. They were always

looking after their own affairs, and never after those of the public." Should we conquer such a people? or add to our territorial dominion? No greater evil can happen to us than falling into such a mistake. The Chinese are not, like the people of India, divided into several nations and into innumerable castes. On the contrary, they are a homogeneous people in race, laws, manners, and religion, with a strong feeling of nationality, which the Hindus and Mahomedans of our Indian possessions are wholly destitute of. Unless largely intermixed with other nationalities, as they now are in all the European possessions in which they are settled, it would be impossible to rule them. The two tribes of Tartars that within the last six centuries have ruled them, men of approximate race to the Chinese, have only been enabled to do so by themselves becoming virtually Chinese, and sharing the government with them. Should we perform the Kutao? Or, by sending our ambassador to Pekin, subject him, as of old, to the insolence and intolerance of the Chinese Government? "I am clearly of opinion," says Mr. Crawfurd, "that our Plenipotentiary ought not to go a furlong beyond the guns of the fleet." It is under those alone that he can negotiate effectually. The vulnerable part of China by an European power is the great river, navigable for a ship of the line for 200 miles. The possession of Nankin and the debouchment of the Grand Canal into the river, which is near it, enables an enemy at once to place the Chinese capital in a state of blockade, by cutting off the southern from the northern provinces, the latter being fed by the former. From 8,000 to 10,000 Imperial junks are, it is said, constantly employed on the Grand Canal in carrying the taxes paid in kind, namely corn, salt, and similar commodities. By the presence of a fleet and land force in the Yang-che-kiang, in the neighbourhood of Nankin, the main channel of intercourse between the fertile southern and the poorer northern provinces is effectually interrupted, and this, as it did on a former occasion, will bring the Chinese Government to terms. It may be said that the insurgents are in occupation of Nankin—this is true, but they are not in possession of the debouchment of the Grand Canal. In taking possession of either it is possible that we may come into collision with a party that is very insolent, very ignorant, and very sanguinary; but these insurgents, pretending

to be Christians, are not deserving of much consideration. Their progress through the whole breadth of China has been marked by rapine and murder, and they consist, without exception, of the lowest and most ignorant classes of the people. Twice they have advanced towards Pekin, and even crossed the Yellow River, and twice they have been defeated and fallen back upon Nankin. Their final success in establishing a native government, and subverting that of the Tartars, does not seem probable; nor is it desirable, for they have no leaders of rank or wealth, and, even if they ultimately succeeded, they would establish a worse government than that they would subvert. They pretend to be Christians, but their Christianity is a profanation of the name, which will not bear examination; and assuredly there is less of the spirit of Christianity in their strange and barbarous religion than in the bloodless worship of Buddha, or the philosophy of Confucius.

To humiliate the Government before such a people in any way that would eventually lead to its overthrow, would be a catastrophe highly prejudicial to our interests. Our object is trade, and what we demand is a free commercial intercourse on terms of equality. No doubt a more decent language has been used by the Chinese since the treaty of Nankin; but the spirit of the Chinese Government in relation to strangers remains unaltered, and we cannot reasonably hope at once to effect a revolution in an inveterate habit which is the fruit of an isolation of 3,000 years. Only, therefore, under the guns of our fleet can our present treaty with the Chinese, in many respects imperfect and ill-defined, be properly rectified, or a new one if necessary negotiated. A demonstration of our power is the most convincing argument. Other nations both wait and watch the result; but in the presence of the assembled hosts it will again be seen that England, although powerful to strike, seeks not alone her own aggrandisement.

Evening Meetings.

Monday, May 18th, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

NEW MEMBERS.

The Chairman announced that since the 1st of January 65 new Members had joined the Institution, viz. :—

LIFE MEMBERS.

Capt. W. Paterson, Professor Royal Military College.
Capt. De La Chaumette, late British Italian Legion.
Capt. W. W. W. Humbley, late 9th Lancrs.

ANNUAL SUBSCRIBERS.

Lt.-Col. Cure, Gren. Gds.
John Leslie, Esq. 71st Regt.
T. Ligertwood, Staff Surgeon.
Capt. Campbell, Sco. Fus. Gds.
Capt. Viscount Kirkwall, Sco. F. Gds.
Lieut. Stephenson, Sco. F. Gds.
Colonel Seymour, Sco. F. Gds.
Capt. Hon. R. Mostyn, Scotch F. Gds.
Lieut. Stracey, Sco. F. Gds.
Lt.-Col. Lord A. Lennox, R. Sus. Mil.
Lt.-Col. Lord C. Hamilton, Donegal Mil.
Lord Hardinge, Kent Artillery.
Capt. Caulfield, Colds. Gds.
Lieut. Barnaud, Colds. Gds.
Col. Wilford, R. Art. Gov. R.M. Academy
Lt.-Col. Reeve, Colds. Gds.
Capt. Mure, Sco. F. Gds.
Lieut. Elwes, Sco. F. Gds.
Lieut. Paynter, Sco. F. Gds.
Lieut. Hon. E. Brownlow, Sco. F. Gds.
Capt. Hon. C. Hay, Sco. F. Gds.
Lieut. Knox, Sco. F. Gds.
Lieut. Jelf Sharpe, Sco. F. Gds.
J. W. Spurrell, Esq. Admiralty.
Capt. Goodwin, Cambridge Militia.
Capt. Digby, Gren. Gds.
Lieut. Fortescue, Colds. Gds.
Earl of Sefton, Gren. Gds.
Lieut. Hon. H. Edgecumbe, Gren. Gds.
Lt.-Col. Read, H.P. Royal Staff Corps.
J. W. Simpson, Esq. late Apothecary to the Forces.
Capt. Ewart, Gren. Gds.
Capt. Scott, Sco. F. Gds.
Col. Shafto Adair, Suffolk Art.
Capt. Harrison, H.P. 79th Highlanders.
Sir Sibbald Scott, Bart. late Sussex Art.
Lieut. Hon. W. Trefusis, Sco. F. Gds.
Lieut. Beaumont, Sco. F. Gds.
Capt. Jervoise, Colds. Gds.
Capt. Burgess, H.P. Bombay Army.
Major Hackett, late 77th Regt.
Capt. Schaw, Roy. Engineers.
Colonel P. Herbert.
Robert O'Byrne, Esq. Navy Agent.
Lt.-Col. L. Graham.
Lieut. Melville, Gren. Gds.
Commander Cole, R.N.
Major-Gen. J. T. Lane, Bengal Army.
Capt. Stapleton, Gren. Gds.
Lt.-Col. Lord Burghley, Nrthmptn. Mil.
Lieut. Murray, R.N.

Lieut. Bulkeley, R. H. Gds.
Capt. Lambton, Sco. F. Gds.
Lieut. Palliser, Rifle Brigade.
Capt. Hon. H. Campbell, Colds. Gds.
Lieut. R. Home, Roy. Engineers.
H. Harkan, Esq. Assist. Surg. R.N.
Lt.-Gen. Cannon.
Lt.-Col. Wilford, Chief Instructor of School of Musketry.
John Davidson, Surg. Ben. Army.
Lt.-Col. G. Knox, late Colds. Gds.
Major Hon. S. Vereker, Limerick Art.

INCREASED SUBSCRIPTIONS.

The under-mentioned Officers had raised their Annual Subscriptions from Ten Shillings to One Sovereign since the 1st of January :—

Capt. Dixon, Q. O. L. Inf. Mil.
Admiral Sir John Hindmarsh.
Major-Gen. Sir R. Doherty.
Lt.-Gen. Sir G. Bowles.
Admiral Lord Aylmer.
Colonel W. Raban.
Capt. Carr, Roy. Marines.
Capt. Goodwin, Bed. Mil.
Lord Hardinge.
Capt. John Grant.
Major-Gen. Monins.
Lieut. Airey, R.N.
Sir Sibbald Scott, Bart.
Colonel Thompson, Ret. R.E.
W. Hunter, Esq. M.D.
Major-Gen. Cameron.
Lieut. Okes.
J. Davidson, Esq. Ret. Surgeon.
Capt. Hon. G. Wrottesley, R.E.
The Rev. G. Gleig, Chaplain-General.

DONATIONS.

Among the more important Donations presented to the Institution since the Annual Meeting were—

To the Library.

The Catalogue and Reports of the Paris Exhibition ; presented by H. M. Government.

Dictionnaire de Bayle, 4 vols. ; presented by Capt. Packe.

The Linesman ; presented by Colonel Napier.

Observations on the Purchase System.

Is England a Military Nation or not ? presented by Sir Robert Gardiner.

Histoire de l'Armée Française, 4 vols. ; presented by Colonel Raban.

Address to the East India Company's College at Haileybury, and Examination of Students at Addiscombe ; presented by Colonel Sykes.

Catalogue of Stars near the Ecliptic ; presented by E. Cooper, Esq.

Meteorological Register of Madras, and Astronomical Observations 1843 to 1852 ; presented by the Hon. Court of Directors.

The Transactions of Various Societies, &c.

Maps and Plans.

Map of Mahon ; 5 Maps of Gibralter at the Siege ; presented by Col. Paschal.

Plan of Kertch—of Scutari—of the Battle of the Tchernaya—of the Camp at Aladyn—of Galala Bunen—View of Balaclava—Series of Eight Plates, showing the Construction of the Docks of Sevastopol—Fac-simile of an Annexe to Protocol of Paris; presented by the Topographical Department of the War Office.

Medals.

A Silver Medal to celebrate the Siege of Gibraltar; presented by Col. Paschal.

Miscellaneous.

A Portrait of Lord Nelson and of the Duke of Wellington, with autographs.

A Medallion of Sir John Franklin; presented by John Barrow, Esq.

Pieces of Russian ration bread—Russian Soldier's Spoon, with blood in the ladle—Cap Pouches—Piece of fuse, which had been lighted to blow up the Magazine in the Redan—Russian Bayonet. Presented by Major Julius Raines, 95th Regt.

ON MILITARY SURVEYING AND RECONNAISSANCE.

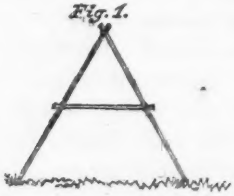
By Captain Baillie, E.I.C.S.

(*Abstract of Paper.*)

Capt. Baillie commenced by observing, that he would take for the text of his remarks the recent Order of H.R.H. the Commander-in-Chief, on the qualifications for staff-officers, especially those of the Assistant-Adjutant-General's and Quartermaster-General's departments, which Order he read to the meeting. He would confine himself to the description of the purely practical methods of military surveying, such as it was within the power of every officer to make himself acquainted with, and which he should be able to apply at any time and under any circumstances, when called upon to do so. Military Surveying might be divided into two branches: 1st. Surveying with Instruments; and, 2nd. Without Instruments. The former was the easier and more correct method; the other being the result only of considerable practice and experience, and limited in a great measure to favourable circumstances of ground and locality generally. Surveying instruments might be classed as, those for linear, and angular measurement. Instruments for linear measurement were required to determine the length of a base line—which was the foundation of every survey,—and upon the correctness of which, the value of the whole directly depended. In military surveys, sufficient importance was not usually given to this the preliminary operation. In books on the subject it was rather slurred over; or they contented themselves with noticing one or two means of performing it—usually by the number of paces of a man or horse. Both these methods were very uncertain—the latter especially so.

Every staff-officer had usually two or three chargers, all probably differing in the length of pace, and each, again, varying its pace under peculiar circumstances. Then it was difficult to count any high number of paces while at full speed, and while, of course, the attention must necessarily, also, be diverted to the direction of the line, and the nature of the ground. Perhaps time furnishes a better mode of estimating distance,—the rate of speed of a cavalry charger being about 400 yards per minute. The other mode of measuring offered a better criterion,—the foot pace. But even this was uncertain. No two men, hardly, however well drilled, took the same number of paces in 100 measured yards, marching independently; and no single man made the same number three times running,—and, when it came to broken and irregular ground, it was of course still less to be relied on. It was therefore of great importance to obtain some simple means of measuring a base "instrumentally;" and the one he (the lecturer) had found the most convenient, was the ordinary pace-stick, with the use of which every drill-serjeant or corporal was well acquainted, by means of which they could measure any distance as rapidly as they could walk, and with the certainty of unvarying length of pace. It was equivalent to the process of "stepping" measurements on paper with the compasses, which till lately had been the only means of dividing straight lines for scales and circles, even of large astronomical instruments. A simple pace-stick could always be constructed with three rods fastened together in an equilateral triangle with two sides continued, as in the fig. (1); or a jointed one could be made by any regimental

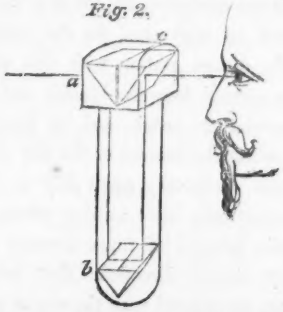
Fig. 1.



carpenter or armourer, and carried as a common walking-stick. There were other instruments especially adapted for measuring distances—such as the perambulator; and various optical instruments

—as the "stadium," and the "rochon," or micrometer telescope. The perambulator was well adapted for route surveys, but was too cumbrous for an officer to carry about with him. In India, a very large one, twenty feet in circumference, usually accompanied the head-quarters of each army. The perambulator might be usefully applied to gun-carriages. They had been frequently tried in ordinary carriages, but failed there on account of the springs, as there was a difficulty in connecting the parts on the wheel, from which the motion was derived, with those on the body of the carriage, where the dial or register was placed. Gun-carriages had no springs, and the objection, therefore, would not apply to them. One perambulator in each troop or battery would be useful; and on fair ground it would easily give a short base from which to ascertain distances for range. The micrometer telescopes were good, but, generally, too expensive for common use. One had recently been produced, which might be referred to, as it differed from all the others in the construction of the telescope, which was on a new principle. It was called the "Napoleon III." field-glass, invented by a French officer, M. Porro, who sought to combine in it the long focal length of the old draw-telescopes with the more compact form of the modern double field-glass. He had done this very cleverly, by folding up the length as it were into four, on the principle of the "optical paradox," only that prisms were substituted for reflectors: the diagram represents the instrument. And it was evident that a ray of

Fig. 2.



light, entering the telescope through the object-glass or prism at A, would be refracted thence up again to C: and so to the eye. The micrometer was engraved on one of the prisms. The instrument

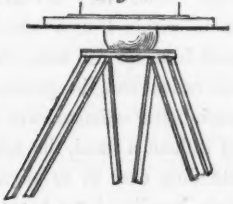
combined great steadiness with long focal distance and large field of view. The cost in Paris was about six pounds.

We will suppose that by either of these methods we have succeeded in measuring a base line; the next point is to select the stations for the various triangles which form the net-work of the survey. The equilateral is the best form of triangle for this purpose, and the angles should never exceed 90° or be less than 30°, as extremely obtuse or acute angles are liable to considerable error. The choice of the marks of the different stations must of course depend upon the nature of the country; they may be trees, prominent rocks, and stones; or buildings, spires, towers, chimneys, &c., afford good marks; but angles of buildings and walls should be avoided, as they are often concealed or undistinguishable from the contiguous stations. In some cases it may be necessary to use artificial marks entirely; the best of these are those which, on the principle of the "Heliotrope," or as it is more correctly called "Heliostat," reflect the sun's rays to the observer, and thus afford a brilliant object visible at immense distances. The heliostat, as used in trigonometrical surveys, is a circular bit of looking-glass about six or eight inches in diameter, whose surface is a true plane; it is fitted into a brass frame, and supported on a horizontal and a vertical axis, so that it can be turned in any direction, either of azimuth or altitude, for military purposes. However, this would be a great deal too complicated and cumbrous; all that we require is a common "shaving-glass," or, if that is not available, the lid of a tin box, or a tin plate or canteen, polished up with sand for the occasion. An orderly might be sent to the distant station with this, and directed to stick up his sword or a ramrod between himself and the position of the officer who is observing the mark, and by keeping the sun's rays playing upon the end of the ramrod or the hilt of the sword he will be enabled to direct them very accurately to the point of observation. The observer may have another mirror at hand, and, by flashing it a certain number of times towards the signal-man, he could convey any simple directions that might be necessary. Persons who are not acquainted with the use of mirrors in this way will be surprised at the immense distances at which the reflected light is visible. In the Ordnance Surveys a heliostat has frequently been observed at distances exceeding 100 miles; and at the Cape

one of only three and a half inches in diameter was almost too brilliant for the telescope at 80 miles' distance. Mr. Galton, in his very valuable and interesting little work on the "Art of Travel," mentions that this plan of communicating signals is used on the plains of Australia and the prairies of America, and suggests its great value to shipwrecked sailors in open boats or rafts on the sea, where their signals are often overlooked. The same principle was also adopted by the Russians at Sebastopol as a telegraph.

We will next proceed to consider the means of measuring the angles and bearings of our station-marks. The earliest and simplest instrument for this purpose was the "plane-table," and, as it is still in use, it may be as well to describe it. It consists of a square wooden frame, or board, upon which a piece of drawing-paper is stretched, and which is supported on a tripod stand. In order to observe an angle or bearing, a flat rule furnished with two brass sights is provided, which sights are adjusted to coincide with the object to be observed, and a line drawn along the edge of the rule gives the required bearing. Formerly plane-tables were very complicated instruments, and in some of the old books on surveying they are represented with every imaginable contrivance of sights, telescopes, compass, protractor, levelling screws and levels, which were supposed to render them perfect, but in reality were only additional sources of error; but it was soon found that the mere expansion and contraction of the paper from hygrometric causes, was sufficient of itself to produce an error of one-half per cent., and consequently no great dependence could be placed upon it, except for small spaces. For military purposes, however, where great accuracy is not required, it is still very useful; and one of the most convenient methods of making and using it is given in the Fig 3. For the table itself a

Fig. 3.



common block "sketch-book" is substituted, to which, underneath, is fastened a portion of a ball of common wood; this rests upon a tripod-stand, in the brass top of which there is a circular orifice (about two inches in diameter) to receive it, and forms with it a ball-and-socket joint, which admits of the surface of the sketch-book being placed truly horizontal. A flat wooden ruler with two needles fixed upright at the extremities, forms the sight ruler, with which bearings are observed and at once protracted. This is all that is requisite, and answers every purpose of the most complicated and expensive affair that can be produced by the mathematical instrument makers. The stand is the same as those now in such common use with photographic cameras, and has only lately come into use in England, but has long superseded the old folding tripod in India for all surveying purposes, and is superior to it from its greater stability. It can be made up anywhere by the commonest carpenter, and is equally useful for the compass, sextant, or telescope.

The next instrument for observing horizontal angles or bearings is the prismatic compass. It is so well known that any description of it is unnecessary. It was invented by Captain Kater for magnetic observation; but, from its portability, and the facility with which bearings could be taken by the "prismatic" arrangement, its advantages over the old circumferentor, or compass with sights, were speedily acknowledged, and it has quite driven that instrument out of the field. The compass card is usually divided to 180° on each semicircle; this, however, is objectionable, and liable to produce error in observation, and the card should in all cases be divided to 360° all round. A ring of silver is sometimes substituted for the card, but this only increases the expense considerably without any adequate advantage. The compass should always be provided with a stand like that of the plane-table described above. This is essential; for, although under very favourable circumstances a bearing may be taken to within 4° or 5° when the compass is supported in the hand, such bearings can never be relied on; the least wind disturbs the observation, and, in general, the angle between two objects can be much better estimated with the eye alone. If the compass must be used without a stand, the safest plan is to place it on the ground, and, standing over it, to align the sights upon the distant object, and then, kneeling down, to read off the angle without

disturbing the compass; this always gives a much closer reading than the other method of holding the compass in the hand, when the very effort of steadying the body and the instrument produces a vibration that entirely precludes accurate observation. Another great source of error arises from the hair-sight of the compass not being truly vertical, which is another argument in favour of the necessity of the stand. In most works on military surveying it is said that the card levels itself, and, consequently, no other levelling is necessary—but this is erroneous; it is not the card which is directed to the object, but the hair: and as it is frequently necessary to observe an object at a considerable height above the plane of the horizon, a very slight obliquity of the hair in this case will produce an error in azimuth of nearly 8° or 10°. Another irregularity of common occurrence, but which is very frequently overlooked, is that produced by what may be called local attractions caused not only by the presence of iron and other elements of disturbance in the earth itself, but, even in flat countries, by the vicinity of large masses of matter, such as houses, trees, &c. which exercise a direct and important influence on the magnetic needle; and smaller bodies of iron especially, which, from their vicinity, have almost an equal effect. It has been found that an observation of a star (Polaris for instance) will differ as much as $1\frac{1}{2}°$ from the reading with the same instrument, and of the same object, taken on opposite sides of a house; and an even greater error would be produced by the proximity of a steel scabbard or sword, a bayonet, or even a bunch of keys, or a knife in the waistcoat pocket, which, perhaps, few officers would think it necessary to leave behind them on a surveying expedition. It is necessary in using the prismatic compass over large tracts of country to be able occasionally to observe the magnetic variation, or, as it is now more commonly called, the declination; this may be done either by direct observation of the Pole-star at its elongations, or by finding a meridian line and comparing it with the magnetic meridian as indicated by the compass needle. Both these methods are described in most works on surveying; but there is another, which is very little known, and which, as it is applicable to many useful purposes in surveying, might be described here. It might be called a simple transit

instrumeut, for it, when properly adjusted, would give the time by the transit of a star, or of the sun, with nearly as much accuracy as the largest and most expensive instrument for the same purpose. It consists merely of a vessel of water, mercury, or other fluid, over which two hairs or threads are stretched at right angles to one another as shown in the figure (4). It is evident that a star or

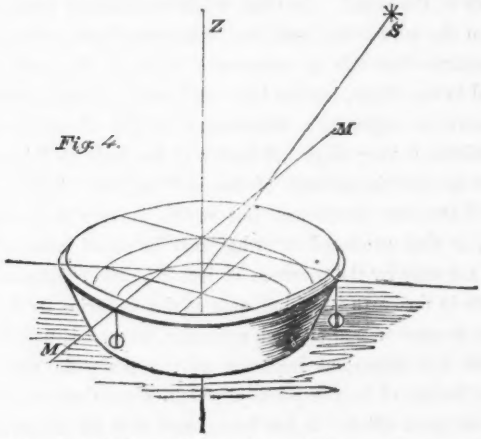


Fig. 4.

other object reflected from the surface of the mercury so as to be bisected by one wire, and its reflected image must be in a plane vertical to the surface of the mercury, and also of the earth at that point; if, then, the direction of the hair could be made to coincide with the true meridian at that place, the star, when bisected, must be upon the meridian, and the time then noted would be its time of transit. To make the hair or wire coincide with the meridian, it is only necessary to obtain sidereal time at the place, which could be immediately obtained approximately by noting the time of transit of a star at or near the zenith of the place (as shown by the reflected intersection of the wires in the mercury), when it must also be near or on the meridian. The right ascension of the star, as given in the Nautical or other almanack, would be the sidereal time of its transit, from which the time of transit of any following star could be deduced; and by moving the wire round, so as to bisect the star at that moment, it would be brought accurately into the meridian, or,

if not quite accurate by one operation, it would be perfected by repeating it. Then by arranging the compass over the vessel of mercury, with its small mirror inverted, we can easily compare the magnetic with the true meridian, and at once obtain the magnetic declination at the place. It may be noticed here that the simple transit instrument here described forms the best sun-dial or meridian instrument that can be constructed; once brought truly into the meridian, it indicates the moment of the sun's meridian passage to a second. In conjunction with the box-sextant it also gives the sun's zenith distance, from which the latitude can be obtained; it is besides applicable to levelling or contouring with the sextant, as will be hereafter described, so that it forms what might be almost styled an universal instrument most invaluable to the military man.

The box-sextant is the next instrument ordinarily employed for military surveying that may be noticed here. It differs from the ordinary sextant only in being smaller and more portable, from its being encased in a box, from whence it derives its name. In general they are divided only to half-degrees, and furnished with a vernier, by which a reading to one minute may be obtained; and, with a little practice, even half a minute may be estimated. They are frequently provided with a telescope, but this is necessarily so small, as only to complicate the instrument, without being of any advantage. It is curious that this instrument is almost unknown out of England, and the writer recently met a French officer in the Crimea, who was exhibiting one, found in the Redan, evidently the property of an English officer, with the use or even purpose of which he was entirely unacquainted, as well as many officers of his own service to whom he had shown it. The method of using the sextant is given in all works on surveying, as well as its adjustments. These should be meddled with as little as possible; nothing tends to destroy any surveying instrument so much as the constant attempt to preserve it in perfect adjustment. This is really impossible; and all that can be done is to observe the index error of the instrument before or after each series of observations. It is necessary also to be cautious into whos e hands surveying instruments are entrusted. He (the lecturer) had on one occasion lent his box-sextant to a gentleman whom he imagined was acquainted with the method of

using it, and who returned it to him shortly afterwards, with the observation that "he had wound it up at both holes, but could not make anything of it." There is an objection to the use of the sextant in surveying—that it does not give horizontal angles, and that a complete series of angles round a station might considerably exceed or fall short of 360°. A little practice, however, would generally enable an observer to select a point above or below the distant station-mark in the plane of the true horizon; and by observing large angles, with long sides, the errors could never exceed those of the prismatic compass in the same circumstances. The effect of an error of one minute in the observation of a station-mark ten miles off would only amount to fifteen or sixteen feet, and for shorter distances it is much less; so that in a military survey, where great accuracy was not required or expected, this objection might be passed over. Each observed angle should be carefully noted down at once in the field-book. But, as even that gave room for mistakes, they should be distinguished by letters—A, B, C, &c.—and roughly plotted on the sketch-book at the same time; and in this should be inserted remarks and sketches of the nature and appearance of the station-points and marks, which would greatly assist the memory in completing the finished plan for submission to the authority for whom it was intended. In general, the unassisted memory should be relied on as little as was absolutely practicable. In the hurry of a rapid reconnaissance, points of the utmost importance would be overlooked or forgotten if left to the memory; while the most trifling pencil-scratch or note actually made on the ground, would help afterwards to recall the scene, and connect the various features of the sketch.

In all field-sketching of this nature, the delineation of irregularities of surface, such as hills, rocks, and broken ground, is the point to which most attention should be paid. If these are carefully laid down, the other features, such as roads, rivers, villages, &c., easily fall into their proper places; and it is precisely the point in which the memory can afford least assistance. The best method of observing differences of level is by running a few contour-lines round the hills at different altitudes; and the sextant is an excellent instrument for this purpose, as by a simple con-

trivance it makes a perfect levelling instrument, which is shown in the accompanying diagram (fig. 5). *a* is the sextant, supported

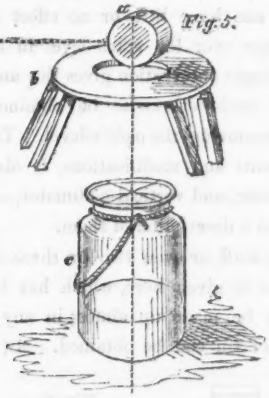


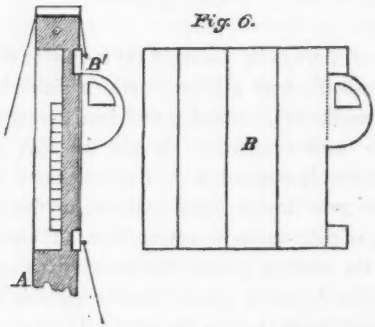
Fig. 5.

at the height of the eye by the stand (*b*) merely to steady it; *c* is a common glass-bottle with a large mouth (a pickle-bottle answers the purpose excellently), containing sufficient mercury to cover the bottom of the bottle completely. Round the neck of the bottle a piece of thick cord is fastened with a loop to carry it by, and over the mouth two cross threads, hairs, or wires, are fixed, with sealing-wax or resin, at right-angles to one another. There is also a tin or paper cap to the bottle to protect the mercury from dust, &c. when not in use. The bottle is placed directly beneath the sextant, so that, on looking down through the top of the stand, the wires and their reflected image in the mercury may be brought into exact coincidence when the eye must evidently be directly vertical to them. If, then, the sextant be set to 90°, and interposed between the eye and the wires, so that they can be seen through it, any object seen in coincidence with the wires in the half-silvered mirrors of the sextant must make with them an angle of 90°, and consequently be in the true plane of the horizon at that place. Suppose such an object were the sight-vane of a levelling-staff, then the indication on the staff would be the difference of level between the station of the staff and the point of observation, + the height of the

eye at *a*. In this way a contour-line could be run in about one-tenth of the time that would be required were the spirit-level used, as the mercury quickly comes to rest, and from the shape of the bottle the wind can have little or no effect upon it. It has also another advantage over the spirit-level in levelling down a steep slope, where a single observation gives the angle of elevation or depression, which could otherwise be obtained only by repeatedly setting up and removing the spirit-level. This "sextant-level," in other arrangements and modifications, is also available as a dip-sector, zenith-sector, and vertical-collimator,—but it is unnecessary here to enter into a description of them.

As a levelling-staff, or even two or three, is required in contouring, a simple one is given here, which has been found convenient, and which may be made up almost in any position where a deal rod and a piece of tin can be obtained. *A* (fig. 6) is the levelling-

Fig. 6.



staff—a common deal rod, about 10 feet long by 1½ inch square, in section—it is divided to feet and tenths of feet, in preference to inches. *B* is a sheet of tin cut out in the form given, so as to fold round the staff, and form a sliding vane. On the part which overlaps, a vernier-scale is made, which enables the staff-man to read the height of the vane to 100ths of a foot. The vane is moved up or down on the staff, according to signal from the observer, by a thin cord running freely through a hole or over a pulley in the top of the staff. The vane being of bright tin can be seen at great distances.

It has been already observed, in the commencement of this paper,

that sketching without instruments can only be acquired after considerable practice and experience. Indeed it is impossible to lay down any rules for it, as the method of making the survey must vary for every locality, and depends entirely on the nature of the distinguishing features of the ground which is the subject of the survey. The usual method was to select the prominent elevations of the ground for stations, and from these to sketch out as much of the ground as could be seen from them, noting especially the points of intersection of the lines connecting the principal stations with each other; in this way a network of triangles was formed, as in a trigonometrical survey, which confined the errors of the position of the features of the ground within certain limits; and it was on the frequency of these intersections that the accuracy of the survey depended.

In conclusion, it might not be amiss to add a few remarks on the delineation of ground in military drawing. This must be always in a great measure conventional, because no merely pictorial representation of the surface of a tract of country, as seen in plan, could afford any indication of its absolute elevations or depressions. It was necessary to introduce shadows, and to exaggerate these even considerably, to produce the appearance of relief, and, where the brush was used, to depict ground. This method of delineation was undoubtedly the most perfect, but it was necessary at times to use the pen instead of the brush, and hence arose the two methods of representing hills now in common use, called respectively the horizontal and vertical methods. These are best described by reference to the effect of water upon a tract of hilly ground. In the vertical method the strokes or hatches of the pen represented the direction which would be taken by water or rain falling upon the top of the hill and running down to its base; the lines or hatches were, consequently, always perpendicular to the "water-shed." In the horizontal method the strokes of the pen represented the lines or "contours," that would be produced by the subsidence, at regular intervals, of a large body of water which has completely covered the hill; the strokes are, therefore, generally parallel to the "water-shed." A good practical illustration of this mode of representing hills was afforded by the "parallel roads or terraces" of Glenroy, in the High-

lands of Scotland, supposed by geologists to be ancient "sea-beaches." Till of late years the vertical method of shading hills was the only one acknowledged and practised in the British or Continental armies; but recently the improvements on the horizontal system, or rather the adaptation of it to "contouring," have rendered it so superior to the other that it will probably entirely supersede it. In the French army this was already the case, and in their topographical department the "contour" system was solely used for the delineation of hills. The relative advantages of the various methods would be better understood by an examination of plans executed in the different styles (which were exhibited during the lecture). Mr. Wyld's Atlas of Battles in the Peninsula showed some good specimens of brush-work (lithographed); but in these the shadows were generally so exaggerated that it was difficult to make out the movements of the troops which they were intended to illustrate. The Plan of Sebastopol, published by our own topographical department, was a specimen of the vertical method; and a plan of the same place, from a French work (the *Journal des Sciences Militaires*), illustrated very beautifully the superiority of the "contour" method, as with a knowledge of the vertical distance of the contours the relative height of any object, and its absolute height above the sea-level, was immediately obtainable. In contrast to all these, some beautiful photographs from a model of a part of the Alps (Monte Rosa) were exhibited; these might be said to illustrate the "pictorial" method, entirely divested of all conventionality, and might be taken as a standard of excellence in brush-work, as the flat shades of the photograph could only be imitated by the brush. A comparison of the conventional methods was decidedly in favour of the contour system as used by the French, without shading of any description; and too much attention could not be directed to the study of this method. It afforded also a very simple method of modelling from Nature, as, if these contours were each traced separately on pieces of cardboard, cork, or similar material, and then cut out and built up in their proper positions, they at once furnished a correct model of the general surface of the ground delineated in the plan. The recent introduction of sand-modelling into our Military Colleges must also prove of immense advantage to young

officers in acquiring a rapid knowledge of ground—in its relation to military purposes. A beautiful specimen of modelling in this style was to be seen at the E.I.C.'s Military College at Addiscombe in the representation of "Ehrenbreitstein and Coblentz;" and it was to be hoped that this system of practical education would be speedily adopted in all our military schools, as, next to actual field-sketching, it was only by the study of models that a young officer could hope to attain real proficiency in Military Drawing.

The Lecture here concluded, but in the discussion which followed some interesting remarks were made by Mr. Galton and General Bagnold on the subject.

Monday, 1st June, 1857.

Colonel the Hon. JAMES LINDSAY in the Chair.

ANNOUNCEMENT.

The CHAIRMAN said,—Before we proceed to the business of this evening, I have a communication to make to the Members of the Institution respecting the Model of Sevastopol; and, in order that the course which the Council have taken for the purpose of obtaining the most accurate representation of the theatre of the late war may be placed before you as concisely as possible, a Memorandum has been drawn up, which the Secretary will now proceed to read.

MEMORANDUM *relative to the* MODELS *of the* SIEGE *of* SEVASTOPOL *and of the surrounding Country.*

In the month of November, 1855, His Royal Highness Prince Albert signified his intention of presenting to the United Service Institution a Model of Sevastopol and of the South of the Crimea. In doing so His Royal Highness made a condition that the Council would take steps to mark in colours, or otherwise, as might appear most advisable, the exact position of the Allied Attack and Russian Defences at the time of the capture of the place, and he hoped that the opportunity would not be lost of acquiring and preserving in a public Institution a correct Model of the Siege.

The Council most thankfully accepted His Royal Highness's offer. The Model was a Cast of one which had been made by Mr. Wyld in the early part of 1855, and which was at that time the only representation in relief of the South of the Crimea then in England, and in that respect was most valuable; but it had been made chiefly from Maps which were in existence before the War commenced, and before any general accurate survey had been made by British officers; and, though it gave with a fair degree of accuracy the general position of the towns and villages and the principal hills, it was found, when the survey of the trenches of the Allies and the works of the Russians was correctly laid down by our own officers, that it was impossible to transfer them on to a model which had not the advantage of being made from such correct data; and therefore, with every anxiety to act up to the spirit of His Royal Highness's wishes, the Council were unable to do more than mark in a temporary manner the positions of the Camps of the Allied Armies.

Colonel Hamilton of the Grenadier Guards, who had surveyed a portion of the ground in front of Sevastopol, had, at the request of the Council, undertaken to superintend the completion of the Model; but, being ordered upon duty to Dublin, he was unable to take any further steps in the matter until the spring of this year.

In the mean time the official surveys of the corps of Royal Engineers and of the Quartermaster-General's Department had been completed, and other valuable sources of information had become known. It was, therefore, thought that the wishes of His Royal Highness would be most thoroughly carried into effect by making an entirely new model, instead of attempting to correct a portion of that at present in the Institution.

At the meeting of Council on the 4th of May, Colonel Hamilton submitted the following proposal: That an entirely new Model of the Siege of Sevastopol and the surrounding country should be constructed, and that a second Model should also be constructed on a much larger scale, showing the advanced part of the Allied Attack and the Russian Defences.

The Council were also informed that His Royal Highness had expressed himself as most anxious to co-operate in any plan that they considered most likely to carry out the object in view.

The Council therefore recognising the advantages of possessing in

the Institution, for the use and study of its members, the most correct and complete Models which the united efforts of the Officers of the Naval and Military services could procure, adopted the proposal submitted to them by Colonel Hamilton, and requested him to superintend their construction.

One Model, on a scale of 1 inch to 480 feet, will comprise the whole country from the River Belbec to Balaklava, and from Kamiesch to Tchorgoun. It will represent—

1st. The positions of the English, French, Sardinian, and Turkish Camps.

2nd. The Siege Works of the English and French Armies.

3rd. The Russian Defences.

4th. The several Battles fought during the progress of the Siege.

5th. The Railroads and various Roads of Communication.

6th. The Intrenchments of Balaklava.

7th. The position of the Allied Fleets off the Harbour at the close of the Siege.

8th. The Soundings round the Coast, from the Admiralty Surveys.

9th. The Northern side of the Harbour as far as the River Belbec and the McKenzie Heights, with the position of the Russian Army.

The second Model will represent on a considerably larger scale the Russian Defences of the Town, with the Advanced Portion of the attacks of the Allies.

Officers possessing Surveys or Sketches of any part of the above country, and who are willing to afford such information as will tend to make the above Model still more complete, are invited to communicate with the Sevastopol Model Committee at the Institution.

The following Officers have consented to form a Committee and superintend the construction of the Models:—

Colonel F. W. Hamilton, C.B., Grenadier Guards.
Captain Moorsom, C.B., Royal Navy.
Captain Fowke, R.E.
Captain Hon. George Wrottesley, R.E.
Captain Elphinstone, R.E.
Lieutenant Donnelly, R.E.
Edward Jekyll, Esq., late Captain, Grenadier Guards.

NEW MEMBERS.

The Chairman then announced that since the last Meeting 14 Officers had become Members of the Institution.

ANNUAL SUBSCRIBERS.

Lieut. R. Crowe, Field Train.
Capt. Vaughan Jones, Unattached.
Capt. Sir W. Wallace, Gren. Gds.
Colonel Campbell, late Renfrew Mil.
Lieut. F. Woodgate, 2nd Life Gds.
Lieut.-Col. Wodehouse, Roy. Art.
Major Davidson, late Bombay Army.
Lieut. Franklin, Roy. Art.
Lieut. Walker, Roy. Eng.
Lieut. G. Phillips, Gren. Gds.
Surgeon Murtogh.
Lieut. Cuninghame, 2nd Life Gds.
Capt. Younghusband, Roy. Art.
Colonel Clark, Roy. Mil. Asylum.

DONATIONS.

The Report of the Commissioners on the re-organization of the system of Training Officers for the Scientific Corps; presented by H. M. Government.

Manuscript of Sir Erasmus Gower, with Observations on a Passage from England to India in 1782; presented by Lord Radstock.

Hand Book for Field Service; presented by the Royal Artillery Institution.

The Militia, and its Importance as a Constitutional Force; presented by Mr. Haggard.

The Traveller's Library, and Summer Tour in Central Europe; presented by John Barrow, Esq.

ON THE FORMS OF SHIPS WITH RELATION TO NAVAL GUNNERY.

By Captain Fishbourne, R.N.

The tendency of the human mind to swing into extremes is such, that it often becomes necessary to call it back from the too engrossing consideration of new discoveries, or of newly disinterred truths, to a consideration of points that may have been and are too often set aside for no better reason than that they are old and appear trite.

This, I contend, has most injuriously been the case in respect of the forms of ships, as compared with the number and character of the guns they carry.

Thus the number and character of guns that any two ships respectively carry are contrasted, and that one which contrasts most favourably in this respect, if she have equal speed, is declared, for

all purposes, to be the best man-of-war; yet, that she is always so is very questionable.

The question involved is important, and one not simply confined to forms of men-of-war, but may, in the present instance, be considered in reference to them. Its importance has never been sufficiently estimated, and it will assume greater value with every improvement in the construction of guns, and with each increase of skill in the mode of using them.

To place two rifles on an equal footing, and to obtain anything like a satisfactory proof of their relative value, it is necessary to fire them from fixed rests,—in fact, long range is of value just in proportion as the support from which the gun is fired is motionless.

Now, if this is true as respects guns whose effective projectiles range 600 or 800 yards, how much more important is it with respect to those in which they range 3000 yards or upwards!

As I am about to state heresies, it is right to caution my audience not to take anything on trust; but it may be permitted to refer to the fact that ten years since I advanced what were then deemed heresies in naval construction, yet the form of each new ship approximates more and more towards the lines then indicated, whether as the result of anything I may have said, or not, is of the smallest importance—the country has obtained the benefit; the fact alluded to, therefore, may be passed over with the remark, that, as I was not so wide of the truth then as some architects desired to make out, I may not be more so in the view I shall now set before you.

There has been a good deal of discussion as to the comparative efficiency of English and American men-of-war. One writer went the length of affirming that he would snap his fingers at many Niagaras if he were in the Duke of Wellington and had the power of motion.

Now, the position I take up is this, that rolling motions, in proportion as they are extensive and frequent, so entirely prevent precision of firing, that any vessel that has this fault, whatever may be her number of guns, or the superiority of their construction or calibre, will be unable to defend herself against an enemy very inferior in every respect but the one, viz. that of her motions being very much more limited in extent and rapidity.

This quality depends upon the fact of the greater or less degree of stability that the ship may possess. Stability may be defined to be

that property in a ship by which she resists inclination or motion round a longitudinal or transverse axis, whatever the disturbing force may be.

Stability is derivable from different causes:—

1st. From the low position of the centre of gravity as compared with the position of the centre of gravity of displacement.

2nd. From the dimensions and form of body, especially of that portion which is subject to immersion and emersion.

But the effects of form must be considered when in motion, whether round an axis or moving horizontally.

This divides itself under three different heads:—

1st. The amount of effect likely to arise, or arising, from a given steady pressure, or the amount of stability at a given angle of inclination.

This has been treated of by Clairbois and other writers, but with more accuracy by our countryman Atwood.

2nd. The amount of effect from a sudden pressure as compared with a steady pressure of equal amount.

This has been treated of by Professor Mozeley in a paper published in the Transactions of the Philosophical Society for 1850.

3rd. The effect produced by a variation of the surface of the sustaining fluid, moving, as it does, the point of suspension.

This last has not been, as far as I am aware, considered by any writer, and constitutes the immediate subject of this paper.

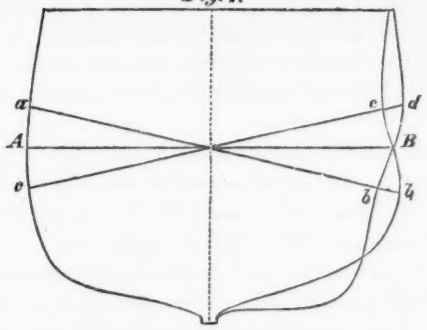
It will be necessary to state only so much of the views of these writers as will suffice to make my argument more intelligible.

The French writers took as the measure of stability the height of the meta-centre, determined for an infinitely small angle of inclination, which was liable to grave error, as it was only an approximate measure, and then only under certain limited conditions, as was pointed out by our countryman Atwood.

The following figure (1) will illustrate this defect.

Stability varying as the cube of the breadth. If the solids of immersion and emersion take the form *e*, B, *b*, then A, B, the breadth at the load water-line used in the calculation, will place the meta-centre too high, while, if it assume the form *d*, B, *b*, the calculation will place it much too low. In the first case the actual stability will be much less, and in the second much more, than the estimate.

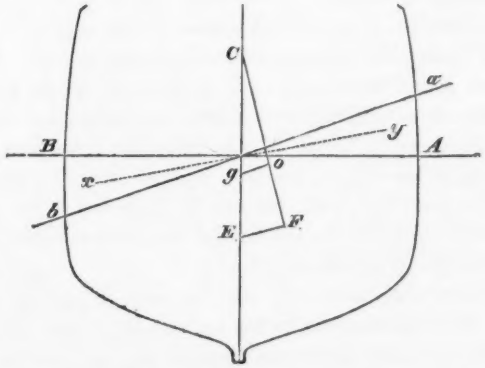
Fig. 1.



Atwood suggested the propriety of estimating the stability or resistance to inclination put forth at a given angle as measured by the contents of the solids of immersion and emersion at that angle, the horizontal distance $x\ y$ of their respective centres, together with the total displacement.

From these E F (Fig. 2) might be determined, and g, the position of the centre of gravity, being ascertained, $g\ o$, or the lever through which the displacement would act in his efforts to right the ship, or

Fig. 2.



to prevent further inclination, might also be ascertained. E is the centre of gravity of displacement when the vessel is upright, F is the

same when the vessel is inclined. A B the water-line when the vessel is upright, *b a* the same when the vessel is inclined.

This Professor Mozeley showed was not sufficient, as it did not embrace all the conditions required; thus, for instance, it did not embrace the question of stability in motion round a longitudinal axis.

He shows that the pressure which would retain a vessel at an inclination of ten degrees, if brought on suddenly, would, owing to dynamic action, incline her to nearly double that, and then occasion a series of oscillations when it did not overturn her.

His paper is a valuable contribution towards an elucidation of the subject, though some of his conclusions are contrary to known facts; he suggests what appears to be a very satisfactory way of estimating the stability, but only in smooth water, viz., by "the work done in raising the body a height equal to the difference of the vertical displacements of its centre of gravity, and of that of its immersed part." When the sea is the cause of oscillation "the work done" is a measure of the ship's instability rather than of her stability.

Though his reasoning is valuable in its place, it does not explain the facts observed, and fails on very important points, but only in common with all other modes of treating the subject.

The point in which they fail is in explaining the observed facts with reference to rolling.

All calculations on the subject proceed on the supposition that a ship is a species of compound pendulum, and subject only to disturbing forces acting horizontally, such as the wind on the sails; one class supposes a relatively fixed point of revolution, and that to be the centre of gravity, though ships do *not* revolve round their centres of gravity, as has been so generally supposed; the other supposes a vertical motion of this point, but only in proportion to the angle of inclination, and to the size and form of the immersed and emerged solids, the *effect of a horizontal force.*

The latter alone is correct, but then only in perfectly smooth water. Each writer overlooks the fact that the normal state of the sea is motion, hence called "the troubled sea," and that the rolling motions are due with scarce an exception to this rather than to any horizontal impulse whether of wind or wave.

I do not mean to say that there is not the slightest analogy at any time between the oscillations of a ship and those of a pendulum, but that there is a manifest difference in the fact that the latter has a fixed point of suspension, and in that the oscillations are produced by a horizontal force which moves the pendulum from the perpendicular, while the former has a moving point of suspension, which is the direct occasion of the oscillations of a ship.

The facts observed not being explainable on the principle of considering a ship's motions strictly analogous to a pendulum, establishes that some other hypothesis is required.

Professor Mozeley, alluding to the *Canopus*, *Bellerophon*, and *Vanguard*, says "the latter should therefore be the least stable of the three." p. 635. Yet this we know is not the fact as respects a horizontal force—the only kind he treats of.

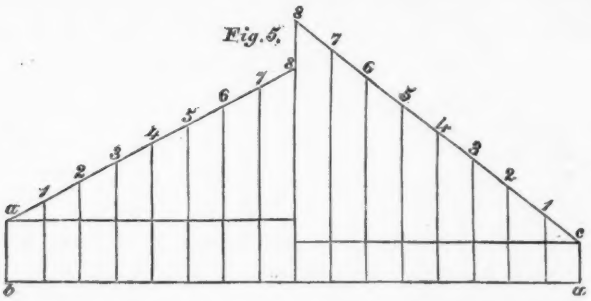
Again he says, alluding to vessels of the *Canopus* and *Vanguard* type, "the former roll more quickly than the latter, but do not roll so far, so that, unless some special provision be made for that end, stability in rolling may not, and will not, probably, be obtained, except at the expense of quick rolling." p. 638.

These conclusions are consistent with the supposition of the strict analogy to a pendulum, but they are contrary to fact. For vessels of the *Canopus* type do *not* roll faster than those of the *Vanguard* type.

Thus the *Rodney*, of the former type, rolled only eight times, while the *Albion*, of the latter, at the same time and place nearly, and under similar circumstances, rolled thirteen times; yet the *Rodney* rolled through an arc of only 27°, while the *Albion* rolled through 49°. Similar facts were observed of the *Canopus* and *Vanguard*, and other vessels of their respective types.

Professor Mozeley treats the question as one solely dynamic, and as a question of relative stability at a given angle of inclination, and supposes that a ship may have greater absolute stability while she may have less relatively to a given angle of inclination.

This may be represented by the following diagrams, in which *a*, *b*, may represent the absolute stability of *Vanguard*, and *c*, *a*, that of *Canopus*; but, as each increment of stability put forth at each additional angle of inclination may be greater in the *Canopus* type,



therefore at 5, 6, or 7° of inclination of each class, the stability of the *Canopus* type would be greatest.

This no doubt may occasionally obtain, but does not under the circumstances in the class of forms he gives, for, as I have shewn, he states that the Canopus type is of a more stable form than the Vanguard type; yet we know that in smooth water the reverse is the fact, though no doubt, as Professor Mozeley shews, if both were inclined to indefinitely large angles, vessels of the Vanguard type would be first upset.

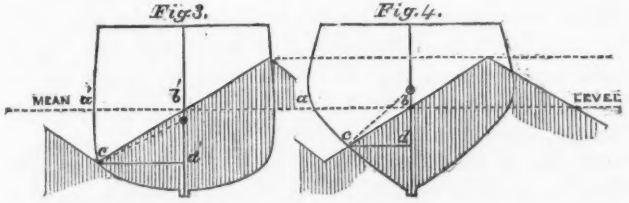
The defect in his reasoning is from treating the greater or less arcs that ships roll through as a dynamic question simply, when in reality it should be viewed as a statical question primarily, in which no doubt dynamics subsequently, and increased action, are involved in an amount proportionate to the statical action.

Waves are the cause of rolling motion, and they are the result of a vertical motion of the particles of water which constitute them—they only have a horizontal motion, not the water, except to a very limited extent, and only occasionally.

This vertical motion commences at and is greatest at the surface, and vanishes altogether at limited depths, varying according to the height of the wave above the mean level; consequently that form of vessel in which the area of load waterline is greatest, as compared with her total displacement, will, in proportion, be subject to more rapid and more extensive motions,—will, in fact, be more sensitive to every agitation of the sea, and afford a less stable platform for guns.

Facts illustrative of the truth of this will at once occur to the

minds of my audience, more particularly those who have ever belonged to a flat-bottom vessel of little draught, — the extent and rapidity of the motions of such vessels under certain states of sea are nearly intolerable. But to those who have not had such experience, and further to illustrate the case, we may assume two sections, which may be taken as characteristic of the general form of



each. Let it be supposed that two waves of equal dimensions are passing across these sections, their crests having passed along the dotted line in the figures.

I have already stated that the motion of the particles of water constituting the waves was vertical; consequently, the forces these vessels are subject to under the hypothesis are the vertical action of the wave, acting through two-thirds $a\,b$ and $a'b'$ (the half-breadth) respectively, tending to cause rotation, and the resistance to immersion offered by the other side, acting through two-thirds $c\,d$ and $c'd'$, but, as in Fig. 3, the levers through which these forces causing and resisting rotation are equal, rotation takes place only because the force which tends to produce it is greater than that which resists it; not simply so in the case of Fig. 4, for not only is the disturbing force greater, but this greater force acts through double the lever, $a\,b$ being nearly double that of $c\,d$; the weight of the bodies represented by Figs. 3 and 4 being equal, and the power applied to Fig. 4 much greater, much more rapid motion must result in her case. Further, whether we suppose the ships homogeneous solids or similarly stowed, the centre of gravity of Fig. 4 would be much higher than that of Fig. 3, and for that reason also would incline more; in other words, her centre of gravity would require to be raised a less quantity than that of Fig. 3 before she were overthrown.

These figures shew the tendencies rather than the actual circumstances that occur, but the argument remains untouched by this; and, as these tendencies give the direction and an estimate of the motions which do occur, it appeared the most simple if not the most correct way of shewing the causes, and illustrating their consequences.

If a line be drawn in each from the centre of gravity to the outer edge of the immersed half-breadth, it will be seen that Fig. 3 will require to be inclined through a much larger angle than Fig. 4, before a perpendicular from that centre would be brought without the base of support,—in fact, Fig. 3 would require to be much more inclined, before it would be overthrown, than Fig. 4.

But now we have to deal with an important dynamical question, which, in its effects, aggravates the faults already dwelt on, for, when the disturbing force is more than is necessary to give the initial velocity, the excess of this force over the resistance to motion is accumulated under the form of *vis viva;* now the excess in Fig. 4, as we have shewn, would be greater than that in Fig. 3 in the inverse ratio of two-thirds of the cubes of their respective half-breadths. But the effect of this *vis viva* is to continue the motion communicated, after the immediate disturbing force has ceased to act in the original direction, then the wave having passed the centre it would tend to set up a new action in the opposite direction.

Where these oscillations of the ship synchronize with those of the wave, the former will increase, and this synchronism will more nearly occur in proportion as stability is due to displacement at the load-water line, that is, when the disturbing forces are greatest, and the motion is least subject to any retarding influence, such as a low centre of gravity, and greater displacement where the water has least motion.

We have an illustration of the existence of a force such as I have described the *vis viva* to be, in the common custom adopted in rolling irregular shaped bodies by a limited power, that of oscillating the body backwards and forwards, and when the arc of oscillation is brought to a maximum to give it a final push, the result of which often establishes the fact of accumulated power.

Captain Nolloth mentions in his journal, published in the

Nautical Magazine, that it is more than probable that the fate of the *Nerbudda* was another illustration of the principle stated above, which was very possible, for she was of the type of Fig. 4, had very little ballast, and left Algoa Bay with a badly sprung mainmast.

The action of the masts is rather favourable in limiting the arcs in rolling, for, as the vessel rolls, they, by their inertia, tend to lag behind and to generate independent oscillations, which prevent those of the vessel from synchronizing with those of the wave; if then her masts went and she were broadside on to the sea, a very possible contingency under such circumstances, the more probable as the seas there are such that vessels are often prevented from answering their helm even with considerable way on, her oscillations will have increased each roll till she has rolled over; if on the edge of the bank, all the more probable, as she would have experienced a walled sea, with a strong current running to windward, all tending to the same fatal result. Similar results nearly occurred to the *Star*, the *Raleigh* (sloop), the *Racer*, and the *Magpie*, all of a *similar* type, which shows the necessity of giving them more ballast and the propriety of not building any more like them.

We have seen that two vessels of similar capacity, differing only in form and distribution of weight, but only so far as their different form entails, are very different in the most essential quality of a man-of-war, that of stability under the ordinary condition of the sea, and that therefore the efficiency of a man-of-war may turn more on the form than upon the weight of broadside she throws.

I may mention a fact illustrative of the different degrees of steadiness in two steamers, both paddle-wheel. Horses could not be carried in the *Hermes* without their being packed so close side to side that they should support each other, having their rumps against the bulwark, and trusses of pressed hay secured to spars placed against their chests, yet the *Birkenhead* carried them without even battens on the decks, while those of the *Hermes* were matted and battened also. But to return to the case of the *Niagara* and *Wellington*. The disparity in the number of their guns prevents the possibility of drawing a direct comparison between them as they are; yet, in very bad weather, the *Niagara* would prove herself an equal. For

First. The *Duke*, under such circumstances, could not avail her-

self of her lower-deck guns, and possibly not of those on her middle deck; and

Secondly. All her other guns would be much less effective from her rolling so much more than the *Niagara*.

But there is no reason why a vessel of the *Niagara's* dimensions should not carry main-deck guns, and be a steadier ship in consequence, in which case she would be a formidable adversary under any circumstances of weather, and should not now be despised, even by vessels of much greater nominal power.

It is manifest, that, under the circumstances of the *Rodney* rolling 20° one way and 27° the other, she could only have used her lower-deck guns occasionally, and then not without great care and some danger, as 15° or 16° inclination would bring the cills of these ports into the water, while it is equally manifest that the *Albion* could not have used hers at all, and thus, though she were a 90-gun ship, she would practically have been reduced to a 60, and these, owing to her more rapid and more extensive motion, would not have been equal to any 40 of the *Rodney's* guns; even the latter would be inferior to a 50-gun frigate of similar form at comparatively close quarters, and vastly inferior at a distance (which those in such a vessel could always choose), as each of her guns would be more effective than each of those of the *Rodney*, because her motions, she not having the weight of the second deck and guns, would be so much less.

The *Niagara*, with her present armament, but under the circumstance of weather, when these vessels were rolling, one 19° and 27°, and the other 32° and 49°, the former 8 times, and the latter 13 times in a minute, would possibly have destroyed either, but could undoubtedly have done so by the *Albion*.

The effectiveness of each gun, under the circumstances, would be in the inverse ratio of the number of degrees they roll through in a minute. Thus—

The *Rodney's* would be $19 + 27 \times 8 = 368$ to
In *Albion* „ $32 + 49 \times 13 = 1053$,

or the effectiveness of a gun in the *Rodney* would be to a similar gun similarly situated in the *Albion* nearly as 3 to 1.

In estimating the value of upper-deck guns, it should be borne in mind that the day is gone by when ships can run alongside each

other and pound away for hours, for the power and practice of gunnery is such, that, unless the ship's motions are very great, a few minutes at close quarters will suffice to settle the action—or one of the contending parties, if not both. It must also be borne in mind, that a good gun in a bad ship will be no more effective than a good rifle in an unsteady hand—the gun and the ship must be held as inseparable in any estimate that may be come to, as are the rifle and the man with his greater or less capabilities to use it: a blockhead will produce in the average as good results with "Brown Bess" as with an Enfield: no better results can be obtained in a ship whose motions are rapid and extensive, whatever may be the goodness of the guns or skill of the gunners. The disadvantage of these bad qualities are such, that if the opponents on the one side are without them, and all other things be equal, the action must be decided in *their* favour almost before they arrive within point-blank range.

Now upper-deck guns are not of much value for distant firing, nor of much value when close, when the object is much below them; and yet the effect of their weight, and that of the deck which carries them, is to increase a ship's rolling, and thus diminish the effectiveness of all guns below them—now, in proportion as a battery is more nearly *à fleur d'eau*, is it effective; and in the same proportion also, other things being equal, is the weight of its guns and deck less injurious in its effect on the motions of the ship; consequently, all upper-deck batteries should be sacrificed in part or wholly to perfect the most effective.

No doubt it is a mistake in the *Niagara* that her guns should be so high, but this is true of all steam-vessels that have only upper-deck guns; but this mistake obtains to a greater extent in two and three decked ships, as their rolling motions must be greatly increased by the weight of their upper decks.

It has been said, and not altogether without some truth, that large ships cannot compete with a number of gun-boats, and yet the bare assertion cannot be accepted as fact, for it may be safely affirmed that, except in the smoothest water, accuracy of fire from gun-boats so small and so formed as ours are, is out of the question—an estimate of them on this point may be obtained from a comparison of the effect of size alone.

The motions of vessels geometrically similar, with all their weights, that of hull included, similarly disposed, are as the squares of their lengths—the greater ship having the less motion.

Thus the motions of the *Duke of Wellington* would be only one-fifth those of one of the gun-boats, and those of the *Great Eastern* only one thirty-fifth of the same.

Nevertheless floating batteries could be designed, that, from their absolute steadiness of gun-platform, with four or six guns, would be more than a match for any of our block-ships; and, from their small draft of water, could take shelter from attacking ships, while, for the same reason, they could defend the shoal parts of our coasts, where block-ships could be of little or no service, and would cost vastly less than the latter.

But this opens the important question as to whether the three-decked ships are not a costly mistake. I confidently affirm that they are; for grant even much less dimensions than those of the *Duke of Wellington*, and a ship might be produced that should possess the qualities of speed, &c. possessed by her in a far higher degree, whether under sail or steam, and, though carrying a much smaller number of guns, would be as effective in smooth water, and vastly more effective in the ordinary conditions of the sea, and more effective in narrow seas, while she would have the further advantage of costing much less, both for a first outlay, and for current expense. No doubt her undue size, and that of others similar, is partly the result of having to use up timber that was cut out for ships like the *Queen*, on which they are certainly improvements, and the two-decked ships are still greater improvements on the *Albion* and *Vanguard*; but it will take many years to eradicate from our navy the evils introduced into it by designs of this type and form; and, notwithstanding the letter I somewhere read, urging alterations in the *Albion*, it is matter of rejoicing that no money is to be wasted in attempts to improve her, for she is radically bad.

For ten or fifteen years we were going in a wrong direction, and we shall probably take as many to return.

Ten years since Sir George Cockburn was anxious to introduce into our navy vessels of the form from which the idea of the *Niagara* was taken, but was prevented by some of his less discerning

colleagues ; but, now that it has been adopted by the Americans, I am told that it is, or has been, recommended for adoption in our navy as something new and valuable. This form, however, is gradually creeping into our navy, and eventually must, when understood, become general ; Her Majesty's new yacht is, in fact, of that form.

The *Diadem* is a step in the right direction; but her guns are too high, the full extent of which evil we shall not arrive at a knowledge of till the suggestions offered by Lord Hardwicke in the House are adopted generally—that of "testing the gunboats by target-practice at sea," and comparing them with other vessels under similar circumstances of weather.

Generally, it would be sufficient to make a careful series of observations on the turns and angles of roll of ships of different forms, together with the effect produced on them by adding or taking out weights, and, if observed with respect to large and expensive ships, all the more important. I may add, that this information would not be confined in its value to men-of-war, but would be of use, if made available, to all the ship-builders in the country. These observations for the most part might be made at anchor in any tolerably open roadstead, and need not entail much expense, and none certainly as compared with their value.

I am greatly mistaken if such ships as the *Exmouth*, and many others, would not prove to be very inefficient in a seaway, from their rapid and extensive rolling-motions.

I am convinced that it would be established that the efficiency of every man-of-war would be increased by an addition to its present quantity of ballast, and that vessels of the *Vanguard* type would benefit most by such an addition, and should receive a greater proportion than any other type of form, as by it the number and extent of their oscillations would be considerably reduced.

The sailing of the latter class would be impaired if nothing more were done ; but the addition of six inches of false keel would correct this. But, as many may be at a loss to understand how keel could produce this result, I will endeavour to explain.

One effect of keel is to reduce the arcs of oscillation; but, as a ship rolls *not* round the centre of gravity, as is generally supposed, but round points alternately on one side and the other of that centre,

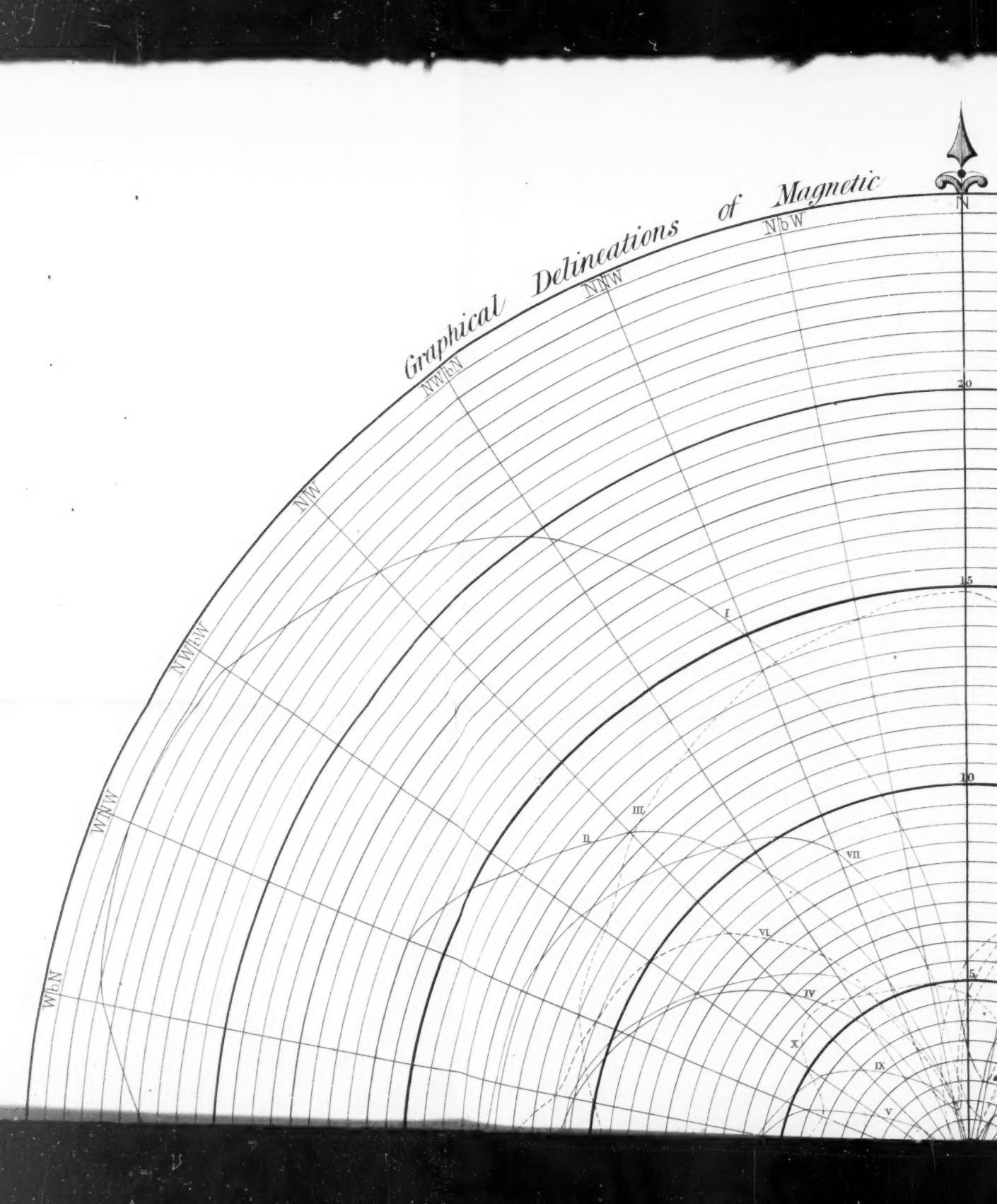
and the more distant the more deep or extensively she rolls, so she presents a more iregular and more changed form of transverse section, and consequently in that degree offers more resistance to motion in the direction of her keel.

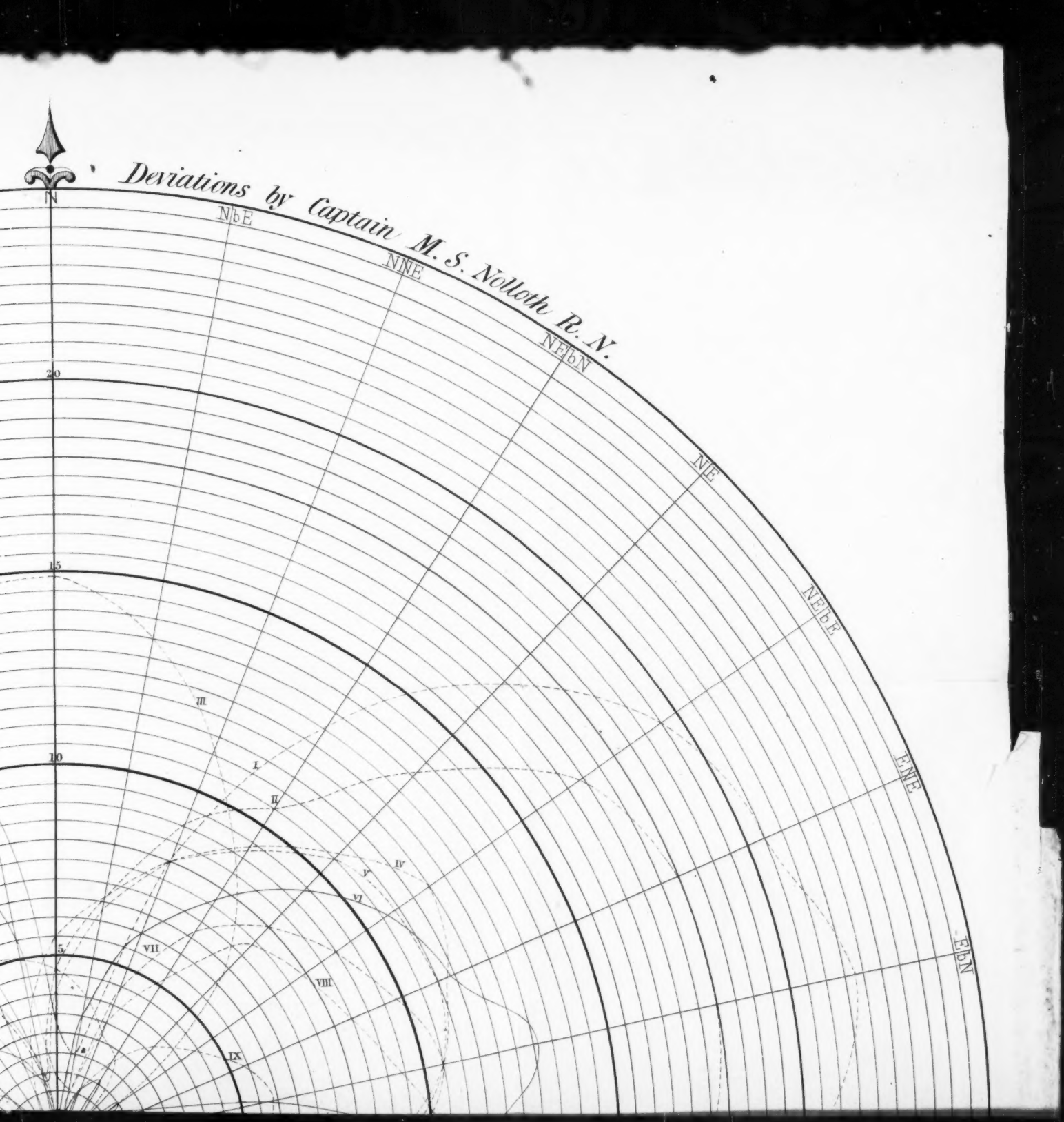
Thus a cylinder, if revolving on its axis, and moving in the direction of that axis, would always and only offer the same-shaped area of resistance; but if the axis were on either side of the centre, increased resistance would result, because this same area, revolving round its new axis would, so to speak, make a larger hole and offer more resistance. Now keel, by reducing these arcs, reduces the resistance, and to that extent contributes to fast sailing, while if the ship be sailing by the wind, or, in any degree a side-wind, by preventing her drift to leeward, in that degree also contributes to fast sailing.

Till we possess the result of many more observations and experiments worthy of the name, naval architecture, to a great extent, must remain sheer empiricism, and the extent to which it is so now, and the great loss which the country sustains in consequence, none can know but those very very few who have really studied the subject—losses which are all the more to be regretted, since they are so unnecessary, but are the result of every sailor, and everyone that pretends to be one, taking for granted that they know all about naval architecture, while it is marvellous the extent to which, and the oracular air with which, fallacies are propounded.

The Government ought to have taken up the subject long since as one certainly not less important than meteorology, in reference to which they are gathering statistics; failing their doing so, private individuals will have to establish a society for promoting naval architecture.

The great American clipper-builder admits that his information was drawn first from lectures which were delivered in your Institution, and thus a new era in naval architecture may be said to have been inaugurated there. It may be that these few thoughts may elicit something further, and help on the formation of a society such as I have allluded to; greater things have had much smaller beginnings. It is time that this great maritime country should lead in questions of maritime science.


Graphical Delineations of Magnetic
N
N b W
NNW
NW b N
NW
NW b W
WNW
W b N
20
15
10
5
I
II
III
IV
V
VI
VII
IX
X


Deviations by Captain M. S. Nolloth R. N.
N
NbE
NNE
NEbN
NE
NEbE
ENE
EbN
20
15
10
5
I
II
III
IV
V
VI
VII
VIII
IX

W
20
15
10
5
WbS
W½S
SWbW
SW
SWbS
S½W
SbW
I
II
III
IV
V
VI
VII
IIX
IX
X
XI

E
ESE
SEbE
SE
SE$S
S$E
SbE
S
5
10
15
20
I
II
III
IV
V
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VII
VIII
IX
X
XI
XII

DIAGRAM OF A DISCOVERY WITH RESPECT TO MAGNETISM.

By Captain Nolloth, R.N.

Captain Nolloth, R.N., exhibited and explained the annexed Diagram, showing the deviations of the standard compasses of eleven of H.M. ships when last swung; the amount of east, or west, deviation observed at each compass-direction of the ships' heads being marked on the point of the compass accordingly.

It appears that, by this method of graphical delineation, a convenient means is afforded of comparing various forms of deviation curves, and of considering them in connexion with the circumstances of magnetic influence under which they respectively occur.

It is also suggested that, in practice, vessels may find this mode of marking (effaceably) the compass card more convenient than reference to a table of figures.

No. in Diagram.	Ships' Names.	Guns.	Tons.	H.P.	——
I.	Trident . .	6	850	450	Paddle steam-vessel (iron —wooden beams)
II.	Ajax . . .	60	1761	450	Screw steamer, guard-ship
III.	Adventure . .	2	1965	400	Screw steamer, store-ship
IV.	Retribution . .	28	1641	400	Paddle-wheel steam-frigate
V.	Conqueror . .	101	3265	800	Screw steam-ship
VI.	Thunder . .	14	1469	150	Screw floating battery (iron)
VII.	Blenheim . .	58	1838	450	Screw steamer, guard-ship
VIII.	Pearl . . .	21	1466	400	Screw steam-corvette
IX.	Amethyst . .	26	923	—	Sailing-vessel
X.	Vulcan . .	6	350	800	Screw steamer, store-ship (iron)
XI.	Victoria and Albert	2 (brass.)	2342	600	Screw steam-yacht

EXAMPLES.

Head by Compass.	Ships.	Deviation.
		° ′
N.E. by E.	Conqueror . . .	10 50 E.
	Vulcan . . .	0 0
	Trident . . .	19 30 E.
	Blenheim . . .	9 0 E.
W. by N.	Conqueror . . .	5 30 W.
	Vulcan . . .	4 20 E.
	Trident . . .	23 20 W.
	Blenheim . . .	12 40 W.

(The ticked lines in diagram denote east, and the full lines west, deviation.)

THE COUNCIL of the UNITED SERVICE INSTITUTION are most anxious to obtain the assistance of SCIENTIFIC OFFICERS of the NAVAL and MILITARY SERVICES in carrying out a useful and practical Course of Lectures at this Institution in the year 1858; and they give this early information of the course they propose to take, in the hope that Officers may be induced to come forward and assist them in this object.

It has been therefore resolved—

1. That the Course of Lectures shall commence in February.

2. That the Lectures shall relate to professional subjects, and to the application of Physical Science to Military Art; Military History; and the Description of Countries in which the British Forces serve.

3. That Evening Meetings shall be held once a fortnight during the Season, or as occasion may demand; Officers are invited to read Papers, or send them to be read. Inventors of articles connected with the Naval and Military Professions will be afforded the opportunity of exhibiting and explaining their Inventions. The fullest discussion is invited.

The Lectures, or an abstract of them; the Proceedings of the Evening Meetings; and the Descriptions of Inventions, will be published in the Journal of the Institution, illustrated, when necessary, by diagrams.

The Council propose to appoint a room in which inventions will be exhibited; and inventors are at liberty to give notice in the professional journals that they are deposited in the Institution.

The subjects which the Council particularly desire to hear treated of in the theatre of the Institution are the following:—

Naval.

Naval Architecture—Steam, as applied to Naval Warfare—Ventilation of Ships—Attack on Land Batteries—Raising Sunken Ships—Astronomy—Meteorology—Defence of Ships from Lightning—Fuel, applied to Steamers, &c. &c.

Military.

Strategy and Tactics—Field Fortification—Passage and Defence of Rivers and Military Bridges—Mining—Military Geography—Topography—Military Hygienne—Surveying. &c. &c.

N.B. Officers who will favour the Institution with a Lecture, or a Course of Lectures, are requested to communicate with the Secretary, before the 1st of January, who will give any information that may be necessary.

By order of the Council,

B. BURGESS, Capt.
Secretary.